ENERGY POLICY AND SOCIAL NETWORK ANALYSIS OF THE CLEAN ENERGY ECONOMY IN WESTERN NORTH CAROLINA: A GEOGRAPHIC PERSPECTIVE ON SUSTAINABLE ECONOMIC DEVELOPMENT

A Thesis
by
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ABSTRACT

ENERGY POLICY AND SOCIAL NETWORK ANALYSIS OF THE CLEAN ENERGY ECONOMY IN WESTERN NORTH CAROLINA: A GEOGRAPHIC PERSPECTIVE ON SUSTAINABLE ECONOMIC DEVELOPMENT

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Research on the development of clustering of clean energy businesses and the social networks that functionwithin them has been sparse, particularly applications within the Appalachian region. This research addresses this knowledge gap by conducting case studies of potential Clean Energy Economy clustering in the Appalachian region of western North Carolina. Methods of this investigation include an analysis of energy policy at varying scales, SWOT analysis, and social network analysis of key community stakeholders in Boone, Asheville, and Hickory-Lenoir, NC. The study areas are analyzed to determine the essential attributes of resilient social networks underlying the Clean Energy Economy in this region. Findings suggest Boone functions as a 'learning region' where specialized knowledge is generated, Asheville as an 'economic hub' where specialized knowledge is disseminated into various markets, and Lenoir-Hickory as an area with established manufacturing infrastructure capable of competing in the renewable energy system components market. Successful businesses in the region thrive at the intersection of collaborative social networks, entrepreneurial spirit, local knowledge and social capital, and policy incentives.

DEDICATION

This research, the preceding graduate experience and accomplishments are lovingly dedicated to my enduring confidant Yosuff Anthony, who has been a constant source of inspiration. This devotion is but a small token of my sincere gratitude for him opening my eyes to the natural treasures and mountain culture of Western North Carolina. I am eternally grateful for him constantly keeping me in line with patience, kindness, insightful guidance, and selfless service throughout the good and bad times of my life. Without his companionship and support this project would have not been possible. May his legend forever live in the hearts of those he has touched and his spirit continue to help humble my soul.

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TABLE OF CONTENTS

ILLUSTRATIONS

Figures

Maps

Tables

CHAPTER 1 – INTRODUCTION

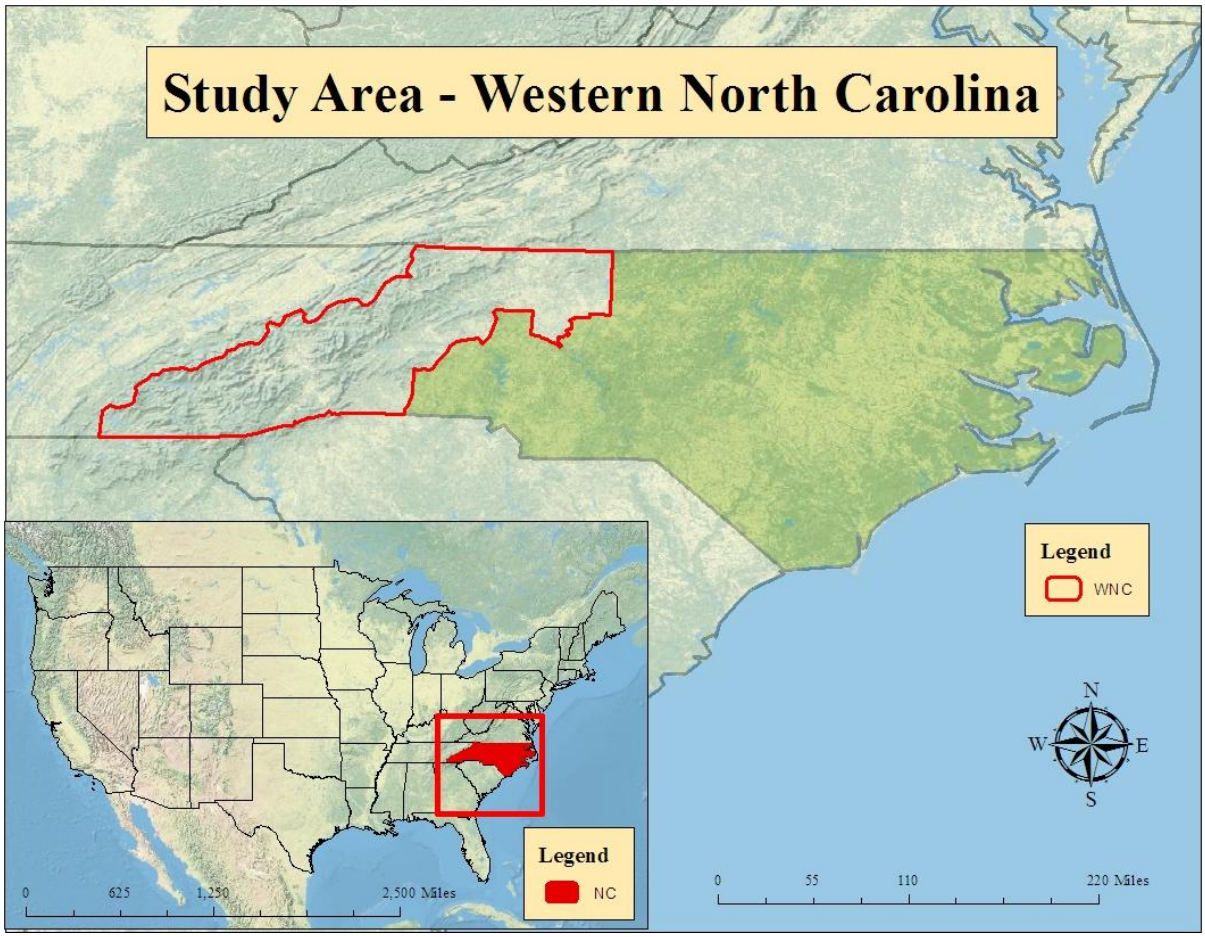
The Clean Energy Economy (CEE) holds promise to both revitalize stagnant economies through direct action and foster a movement which, ancillary to backing the CEE, can indirectly alleviate burdens that follow sustained economic downturn. For the purposes of this thesis, the CEE is defined as any economic activity that establishes and maintains sustainable foundations that address economic, equity, and environmental (E3) issues. These activities, also known as "green business," are present in diverse economic sectors including, but by no means limited to, agriculture, manufacturing, and retail. Indeed, capitalizing on the CEE's sustainability principles creates new opportunities to advance economic development and stability. Today, concern surrounds the progressive exhaustion of natural resources. All too frequently, this anxiety dissolves into contentious and, typically, fruitless battles over associative social issues rather than impelling stakeholders to develop successful prescriptions for energy challenges. The CEE assuages such concerns, thus avoiding future disruptive conflicts, by means of diverse, locally-appropriate solutions. In this way the CEE is made manifest as a paradigmatic shift from a globalized to a localized economy and, by extension, toward more sustainable life choices.

The energy sector is a principal advocate for the CEE and it will surely remain a cornerstone in endorsing its expansion. As Hoyle suggests, "clean energy technologies and sustainable management like renewable energy and energy efficiency are crucial growth opportunities for economic recovery" (2009, 2). Energy Efficiency and Renewable Energy

(EERE) technologies are especially vital to initiating change throughout political, economic, and environmental landscapes. This study will focus on how sustainable principles, in general, and CEE initiatives, specifically, are effectively integrated with regional economies. The objective of this research is to identify the requisite attributes for establishing a successful sustainability cluster in Western North Carolina (WNC).

Located in North Carolina's mountainous west, the study area is a constituent of the Appalachian Region and spans laterally across the full length of the state's western boundary (Map 1). This charismatic area regularly attracts numerous tourists and second-home owners who enjoy its bountiful natural beauty throughout each of four distinct seasons, its culturally unique music and art, and touring through its quaint mountain towns via such public infrastructural amenities as the Blue Ridge Parkway. This area is largely rural and counts few well-developed urban hubs among its incorporated communities. While the area "suffers from high rates of under-unemployment, poverty, and low rates of per capita income" (Glasmeier and Bell 2006, 9), it also holds "dynamic potential for growth in the energy sector considering growing energy demands and standards towards becoming energy independent" (Glasmeier et al. 2007, 3). Boone, Asheville, and Lenoir/Hickory are this area's innovation hubs and each could support development of the CEE's energy sector. This research will qualitatively analyze energy policy and social network case studies for each hub with the purpose of evaluating how similar sustainable clusters might be developed throughout the southeastern United States in the near future.

This research endeavors not only to identify what attributes characterize CEE clusters but also to develop a set of best practices for capitalizing on a cluster's specialized knowledge to propel economic development in surrounding areas. By understanding the CEE



Map 1. Study Area - Western North Carolina

clusters/social networks dynamic, areas can be more accurately targeted for economic development and CEE practices can be better implemented on a variety of scales. By investing in local energy independence, the process of creating resilient communities can be made more lucrative, efficient, and equitable (Jones 2008). This research also contributes to ongoing efforts to provide pragmatic remedies for reducing instances and long-term impacts of ecological disaster and environmentally detrimental activities, respectively, which remain central to conventional globalized capitalism. Furthermore, by understanding how sustainable clusters develop and establishing their social, political, and economic value to the United States, E3 research contributors can begin to offer alternatives to an increasingly unhealthy reliance on fossil fuels while concomitantly helping to create resilient communities

with the means to invest in their unique particularities of place. The knowledge gained from this research will help such learning institutions as universities, community colleges, and non-profit institutes better understand their roles within the economy and help them seize opportunities to usher in institutional policies that promote the dissemination of relevant specialized knowledge into the market. In addition, elucidating the various dynamics of sustainable cluster interactions can help improve the ways this type of knowledge is transferred, which can be appreciably instrumental for informing decisions on how best to solve several interrelated E3 research problems. Finally, when the attributes of sustainable clusters are identified, proactive implementation of policy and incentives can potentially be applied to develop similar enclaves of creative, sustainable, pro-market, E3 problem-solvers throughout the United States.

The need for further research on how clusters operate and better identification of their attributes are well-voiced all through academic disciplines, informal spheres of political influence, formal political institutions, and professional industries. This research contributes a focused examination of energy policy and social networks in the Appalachian Region. Region-specific challenges cannot be overcome in absence of a complete understanding of the dynamics at play between geographical profiles and the examples of successful CEE clusters. By identifying cluster attributes, this study can potentially inform the design of more accurate models to measure how closely the responses to social, economic, and political stimuli resemble the designers' desired outcome for successfully redressing challenges as varied as global climate change and local economic development. There are limited case studies of both cluster effects and the social networks that function within them; studies carried out within the Appalachian region are particularly scarce. This research aims to fill

this knowledge gap by offering insights as to how to establish CEE clusters by analyzing energy policy and social networks of and relating to WNC. To address this, the following three questions are considered:

(1) What are the attributes required to establish successful clusters of CEE businesses defined by the following criteria: specialized knowledge of sustainable principles and practices; local, state, and federal policy and policy initiatives; local and global economic profiles; and locational advantage factors?

(2) What types of energy policy and social networks currently exist to establish a CEE cluster in the WNC?

(3) How can these findings be used to influence local economic development and energy policy?

Identifying the knowledge processes, policy implementation, economic profiles, and particularities of place that characterize WNC will ultimately support the argument for the study area as a nascent CEE cluster that may, in due course, manifest as force that drives regional economic development and adds momentum to the Green Economy. Case studies on Boone, Asheville, and Lenoir / Hickory clearly identify attributes to such an extent that the process of knowledge production is quantified and the social network that binds is visualized. Exploring the social interactions of organizations in this region through CEE policy analysis and social network analysis can produce a clearly defined, useful understanding of what constitutes the region's collective identity. That understanding can more accurately inform political decision-making so that new solutions to this area's problems are locally-appropriate and targeted regulation programs which promote economic development are

proactively initiated. Results from this analysis may therefore serve as a potential guide to initiating CEE clusters.

There are four key rudiments to investigating CEE clusters: (1) synthesizing the different scales of energy policy and incentives through all government levels, from federal to local, (2) identifying case study geographic profiles, (3) analyzing potential strengths, weaknesses, opportunities, and threats (SWOT) of implemented CEE clusters in the Boone, Asheville, and Lenoir / Hickory areas, and (4) conducting qualitative interviews with key stakeholders in the case study communities.

As Rome suggests, "review of energy policy aids in sketching a landscape of American conservation efforts and help to better understand how current E3 situations have developed" (2001, 84). Public policies similar to North Carolina's Renewable Energy Portfolio Standard and Senate Bill 10-68 are essential to understanding how the state provides directive guidance concerning energy issues. The Database of State Incentives for Renewable Energy (DSIRE) from North Carolina State University is also utilized to identify federal and state incentives for the implementation of EERE technologies.

The SWOT analysis identifies the strengths, weaknesses, opportunities, and threats of the Boone, Asheville, and Lenoir / Hickory areas and thus provides valuable insight for those determining the feasibility of CEE clusters based on existing and potential community qualities and characteristics. The sample sites for the case studies were chosen based on the rationale that these areas are regional hubs of activity. Boone is believed to be an area where individuals conglomerate to create and experiment with specialized knowledge and this accounts for it being the acknowledged foundation of the CEE. Asheville is believed to be an area where like-minded individuals conglomerate to disseminate specialized knowledge into

various markets and sectors of the CEE. Lenoir / Hickory are believed to be areas of existing infrastructure conglomeration where CEE components can potentially be manufactured.

A crucial aspect of this research involved conducting a qualitative analysis of social networks through interviews with key informants; in addition to obtaining valuable perspectives on relevant social capital landscapes, these interviews helped gauge the SWOT analysis. The interviews were conducted similarly to the methods used by Henry and Pinch (2000), in which semi-structured interviews with key informants from the most influential organizations are used to provide an accurate description of the social network underlying Motor Sport Valley. The purpose of the interviews was to gain an expansive understanding of the nature of the social networks at play in the study areas. The social network mapping will consist of creating an industry inventory and network diagrams from the triangulation of findings, utilizing the methods of social network graphics and analysis of social network topology (Barabasi 2005; Scott 1991; Yuan and Hornsby 2008).

CHAPTER 2 – LITERATURE REVIEW

In our modern world energy equates to power, not so much in the scientific sense but rather in terms of control. Energy is a crucial component of developing societies that grants the ability to move forward in the name of progress. Energy is the fuel that powers economic, political, and social agendas. To better understand where the United States (US) is heading in terms of energy, it is important to understand the nation's historical relationship with energy. This review of how the US's current energy paradigm came about will be broken down into four subsections: 1) centralization of energy use through the electrification of the US, 2) diversification of energy sources initiated through social and political movements, 3) identifications of the true costs of energy through externalities, and 4) spatial clustering of businesses and social networks in business.

Social movements have played a crucial role in shaping the US's energy landscape. The movement of change to alternative energy sources is progressive in the sense of solving the problems of unintended consequences from the extraction, production, and consumption of fossil fuels. These unintended and often overlooked consequences create negative effects throughout E3 realms known as the true costs of energy by "shifting from fuel systems that rely on finite substances of decaying life to those that promote the growth of life, the collective we can ensure that mankind continues to thrive for generations to come" (Jones 2008, 10). The implementation of sustainable principles through the adoption of alternative

energy sources is capable of addressing the far-reaching and interrelated world-wide problems linked to the true costs of energy.

CENTRALIZATION OF ENERGY

To recognize energy's role in the US it is essential to understand the American Lifestyle. The current iconic American Lifestyle can be traced back to the post-WWII era when the US was moving forward with the economic progress from post-war production. When Americans returned from WWII, a plethora of economic development opportunities (e.g., subsidies and low-interest loans) existed. These opportunities promoted the timely growth of families and their quality of life. With the manufacturing boom still present in the market from war production and the means of increasing quality of life, the US was ramping up for never before seen rates of consumption and by "mid-1940 the baby boom had begun as families began to grow at exponential rates" (U.S. Center for Disease Control and Prevention 2008). In response, "consumer materials such as automobiles, homes, and appliances were increasing in demand with the growing population and development" (Rome 2001, 45). As the supply was being met, a growing demand of energy to power the newfound American Lifestyle was required to perpetuate the growth and development.

Rome explains that a "major mechanism that drove the modernization, and essentially the electrification, of the US is the trend-setting housing development beginning in the 1940's and 1950's" (2001, 61). As men returned from WWII, women returned to the home, and families grew as birthrates skyrocketed and economic opportunities flourished. One of the ways Americans were able to enjoy their newfound prosperity was by investing in new homes. As the demand for housing exponentially increased, and more importantly the means to obtain it boomed, industrial methods and modes of production were applied to the housing

industry. Rome comments that a "crucial aspect of the housing development from this period onward that greatly affects energy consumption is the replacement of regional-based designs (i.e., compatibility to site specific climates) to mass-produced, market-based housing designs to meet growing demands" (2001, 60). This effectively put generic housing on the market that was designed as an economic catalyst, aesthetics catering to prosperity rather than a functional living environment system. This change in "regional home designs equated to massive increases in electricity consumption from the 1950's forward" (U.S. Energy Information Administration 2009).

The combination of changing housing designs, production methods, and the evolving American Lifestyle of convenience lead to advances of supplemental technology that pushed the agenda of industry leaders to develop all-electric homes throughout the US landscape. Though the gradual increase of household appliances was directly proportionate to the increase of electricity demand, the innovation of climate control in the 1950's and 1960's explains the dramatic increase of residential electric demand. Air Conditioning (AC) was the first of climate control conveniences that was applied to compensate for the lack of regional design leading to "the development of all-electric homes through the installation of Heating Ventilation and Air Conditioning (HVAC) units" (Rome 2001, 64-65).

The American Lifestyle was driving the development of electric-related industries while at the same time being shaped by the very same industry leaders who were strategically creating economic opportunities by increasing the demand for electrification (Figure 1). Rome postulates that "a variety of industry partnerships mutually benefited from the all-electric home design changes and throughout the 1970's and 1980's the US called into question the use of coercive tactics of electric-related businesses to monopolize markets"

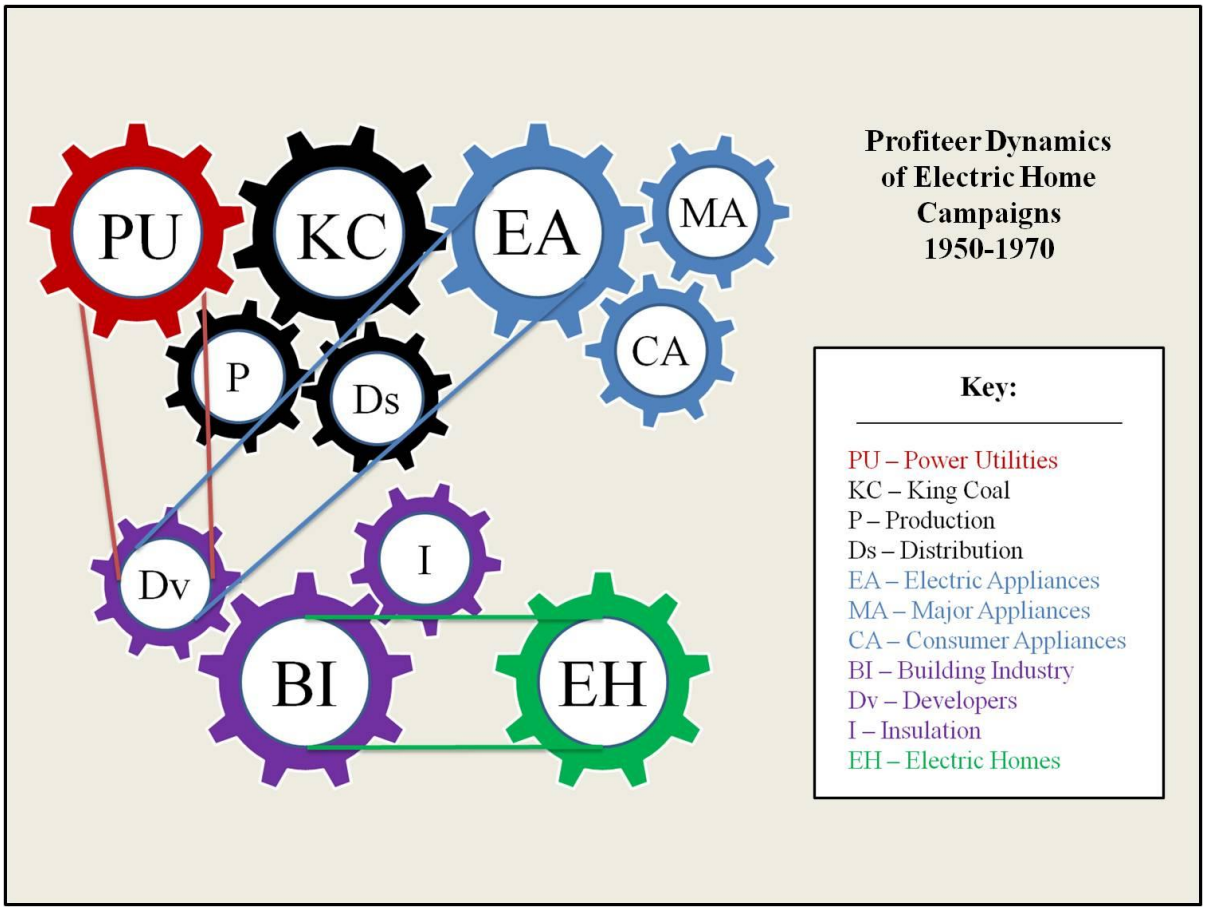


Figure 1. Profiteer Dynamics of Electric Home Campaigns 1950-1970. *Source*: Data from Rome 2001.

(2001, 80). Lash and Urry explain the "interconnection of major companies (e.g. Morgan, Rockefeller, and Du Pont) to that of legislative and executive level government officials helped early regulatory efforts embed themselves even further into the American Lifestyle and mold the characteristic traits of big businesses driving the economic and political arenas" (1987, 68). After a series of legislative efforts to break up monopolies, stop unethical business practices, and implement regulatory standards in the energy sector, the need to diversify the US's energy supplies began a new era.

DIVERSIFICATION OF ENERGY

The diversification of where and how the US supplies its energy needs can be understood by analyzing the major political and social movements that were happening during and after the centralization of energy efforts in America. For example, "a major shift in social change of the time initiated the implementation of political change oriented towards civil rights, which inevitably lead to environmental movements and legislation" (Simon 2007, 10). The movements that have historically affected energy policy in the US have been through a combination of particular economic needs of the times, dominant political party views, and social changes. Energy policy most often grows from environmental movements and awareness, generally following a lag effect until becoming initiated as official legislation and regulation (Table 1). Simon reports, "the environmental movement of the 60's and 70's describes how a social movement is forged where society realizes the significant costs of energy consumption, generating a movement in alternative and renewable energy technology that is environmentally responsible and subsequently sets the foundation for the NEP in the 80's" (2007, 11). Some of the most notable and influential legislation that has affected energy policy in the US can be traced back to the presidential terms of Nixon and Ford, Carter, Reagan, Bush Sr., Clinton, and Bush Jr.. Although it is too early for this research to determine the effects of President Obama and his administration, his presidency is expected to hold substantial energy policy reform.

"President Nixon and Ford can be identified as the beginning of an era when the US enacted legislation based on a commitment to environmental issues that equated into national energy policy" (Simon 2007, 13). Some of the most notable policy of these presidencies

Table 1. Issues to Consider when Studying Policy Innovation. *Source*: Simon 2007.

Environmental Factors
Is innovation driven by a real or perceived crisis?
Are policy stakeholders satisfied with the status quo?
Is the potential culture of a jurisdiction conductive to policy innovation?
Are the socioeconomic conditions in a jurisdiction favorable to innovation?
Are adjacent states and local governments engaged in policy innovation? If so, what are the social and economic impacts of the policy innovations?
Ideology and Values
Are elected representatives supportive of policy innovations?
Are citizens supportive of policy innovation?

includes the National Environmental Policy Act (NEPA), Clean Air Act (CAA), Energy Reorganization Act (ERA), Energy Policy and Conservation Act (EPCA), and Resource Conservation and Recovery Act (RCRA), and the establishment of the Energy Research and Development Administration (ERDA). President Carter can be identified as the front man for Alternative and Renewable Energy, considered the single president to date making the most progress for sustainable development in the US (Simon 2007). Carter's most notable policies include the Department of Energy Organization Act (DEOA), which established the Department of Energy (DOE) and its Office of EERE and made way for the National Renewable Energy Laboratories (NREL). Other influential energy policies included the National Energy Conservation Policy Act (NECPA), Energy Security Act (ESA),

Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA); and the National Energy Act (NEA) which established one of the nation's most influential bodies of legislation for implementing alternative and renewable energy – the Public Utility Regulatory Policies Act (PURPA).

President Reagan can be identified as President Carter's opposite, the front man for nuclear technology, and began the resurgence of commitment to petroleum, natural gas, and coal as primary energy sources (Simon 2007). Reagan's most notable policy includes the Nuclear Waste Policy Act (NWPA), Electric Consumer Protection Act (ECPA) and the National Appliance Energy Conservation Act (NAECA). President Bush Sr. followed in the footsteps of President Reagan and the Republican Party's views, with the debatable consideration of a more environmentally responsible outlook of free enterprise's role in conservation efforts. Bush Sr.'s most notable policy included the Pollution Prevention Act (PPA) and the Energy Policy Act (EPAct).

The importance of oil to the US economy and its way of life can be exemplified by the impacts of the 1940's, 1970's, 1980's, and 2000's energy crises, which created widespread economic distress and social unrest. It is in the time of crises that change is more apt to happen, in these cases the importance of researching and developing alternative and renewable energy sources became evident. Alternative energy sources were invested in heavily considering the alarming nature of a society's dependency on a depleting energy source.

In addition to domestic legislation and regulations, oil has played a crucial role in US international policy and continues to be a driving force of global economic affairs. "The Organization of the Petroleum Exporting Countries (OPEC) embargo and Iranian Revolution

are examples of the international economic impacts of oil and illustrate the dependency of the US on oil and required diversification of depleting fossil fuels to power the nation" (Simon 2007, 18). War is an additional undesirable byproduct of international politics related to resources and in particular that of oil demonstrated in events such as the Gulf and Iraq Wars. The US is divided upon such efforts to sacrifice our nation's youth, resources, integrity, and future relations with other countries to grasp at a depleting energy resource that continues to fuel an unsustainable lifestyle.

Nuclear technology was developed and engineered out of war-time needs and threats. The US lead the race to nuclear arms through the Manhattan Project, ultimately developing and utilizing the technology to bring Japan to its knees, putting an end to WWII. A consequence of demonstrating such a military capability of nuclear technology caught the attention of other world powers, prompted the stock pile of arsenals, and cast a shadow of fear upon generations to come of a potential nuclear holocaust. Fortunately the understanding of the real and present danger of a nuclear armageddon has been realized by world powers and possessors of nuclear arms, initiating measures such as the Nuclear Non-Proliferation Treaty to assure that the technology is no longer put to devastating use. Nonetheless, the potential of human error is dangerously present in the possession of the technology and shadows the potential benefits of such.

The energy production capability of nuclear energy is however another use of the technology and has been proven to provide an unimaginable source of energy. Nuclear technology is used in a variety of ways, from smoke detectors to power plants. The advancements in nuclear technology have come a long way since the 1940's, in particular the process advancements away from fusion and more towards fission. The infrastructure

required to generate economical scales of nuclear power production are substantially large and must be implemented with sizeable capital investment, effectively monopolizing the industry for large-scaled power providers. The scalability of nuclear power then raises equity questions of application for rural areas with lower or below average levels of energy demand. However, the potential devastating environmental impacts of nuclear produced energy can be exemplified through both the Chernobyl and Three Mile Island accidents. The environmental impacts of producing nuclear energy also include consequences to aquatic ecosystems through the cool down process of power plants. Nuclear energy also produces a byproduct of waste that is extremely hazardous and has proven to be a challenge to dispose of responsibly. In short, nuclear technology still holds unfathomable possibilities, but until we can fully master the processes of responsibly creating energy, it poses a great threat to generations to come.

TRUE COST OF ENERGY

In addition to some of the previously noted impacts of energy, there are other often overlooked hidden costs of extracting, producing, and consuming fossil fuels that are interconnected and overlap the realms of Economics, Politics (Equity), and Environment. The culmination of these unforeseen consequences, juxtapositions, and externalities is known as the True Cost of Energy (TCE). Whatever lens energy is examined under, it is intimately connected to our lives from the fundamental principles of societies to material extravagances, in remotely undeveloped areas to highly accessible and sophisticated parts of the world.

As developed nations continue to grow they wrestle with the notion and implications of the inevitability that carbon-based energy sources are finite. With this realization we are also granted a unique hope, a silver-lining in the dark storm ahead to forge a new future that

can address these TCE's by capitalizing on natural elements and processes. In his book *The Green Collar Economy*, Jones identifies the widely accepted idea of a Dual Crisis where we are faced with a doubled sided option: "to either continue to deplete the remaining fossil fuel reserves which cause environmental havoc in an attempt to revitalize economic activity, or to stop using fossil fuel and jeopardize the economy" (2008, 60). This idea that the environment is embedded in and ultimately tied to the critical energy choices we will make in the coming years brings the concepts of sustainability full circle.

The use of carbon-based fuels negatively affects the entire world as fossil fuels are the leading contributor to Greenhouse Gas (GHG) emissions and the driving force behind Global Climate Change (GCC). As its name implies, GCC is the process of climate change on a global scale. From melting ice caps to changes in weather patterns to species spreading out from indigenous climate zones, GCC is a real and present danger of disturbances to natural equilibriums and the collapse of ecosystems (Figure 2). These and other environmental issues linked to GCC are transforming our world at exponential rates as we continue to use fossil fuels. Incidences like Hurricane Katrina are examples of natural disasters that can be expected with the fluctuations of extreme weather events. It is important to note the far-reaching economic and equity impacts in addition to that of the environmental effects of extreme weather events like Hurricane Katrina. For example, "economic effects included hard hits to the oil industry that shut production down for approximately six months, forestry destruction throughout the Gulf Coastal area, devastation to local economies' infrastructure, and the largest redistribution of Americans in history" (Deal and Lessin 2008). Although natural disasters do not discriminate, the largest demographic affected by the storm was the poor.

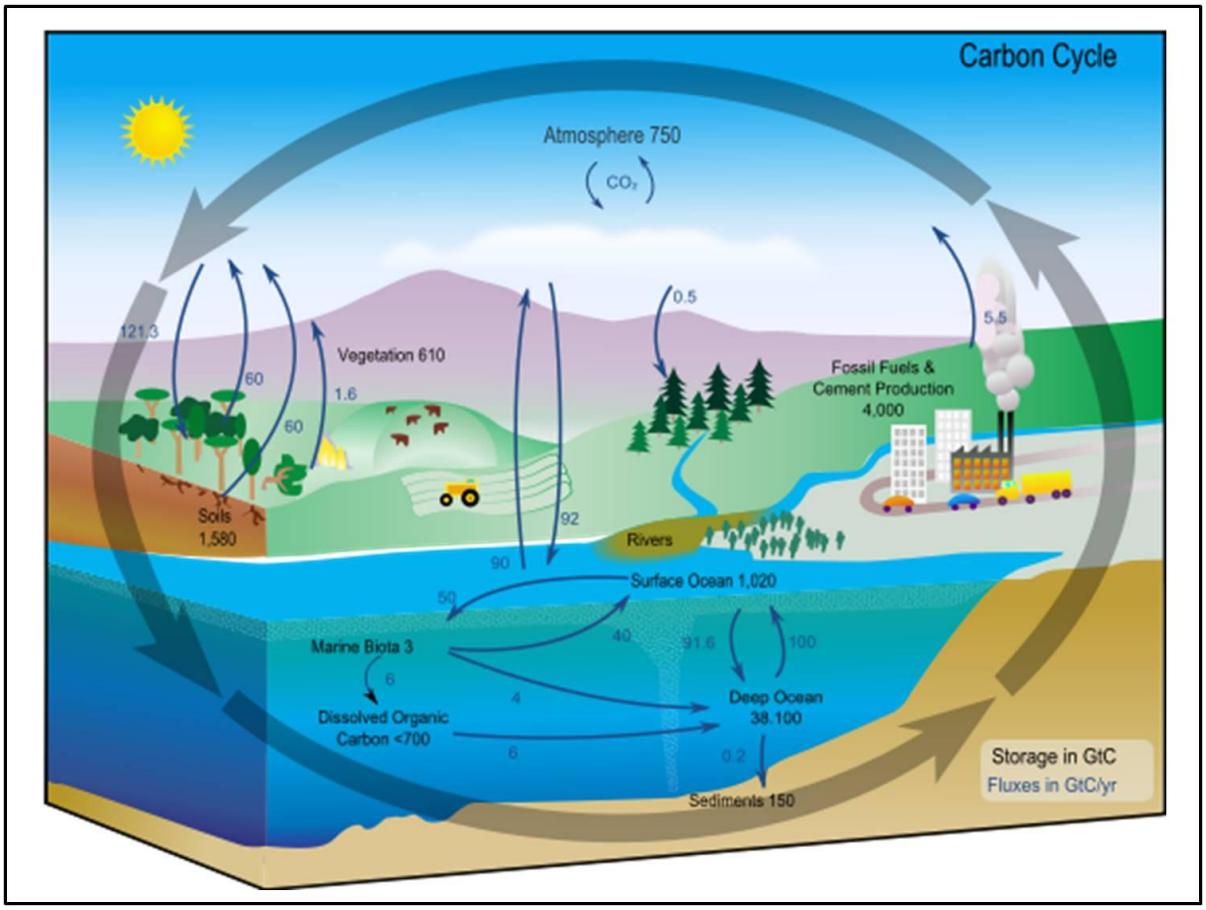


Figure 2. Example of Complex System – Carbon Cycle. *Source*: NASA 2010.

The economic law of supply and demand dictates that the remaining carbon-based energy sources will continue to rise in costs, creating exponential equity issues until depletion. As Postlethwaite suggests, "although the results of carbon-based fuel depletion are unknown, one can only imagine what civil unrest will ensue when these energy sources dwindle and only the rich can afford them" (2008). This concept brings into question mismanagement and leadership issues that have been witnessed in energy crises of the past that are pivotal to economic and equity issues. For example, Gibney reports that the "Enron scandal for example was an epic mismanagement of and wide-spread corruption within the energy sector that resulted in not only economic havoc but also health and safety concerns

from the staged blackouts (2005). These and other far-reaching effects of the TCE can only be limited by our imaginations and prove to be plenty of reason as to why we should care about the unintended consequences of using carbon-based fuels.

The alternative energy sources we currently have available at our disposal are able to significantly reduce most if not all of the TCE from carbon-based energy. These alternative energy sources rely on natural processes are known as renewable energies. The different forms of renewable energies range from solar power, wind power, hydropower, geothermal, and biomass. Solar power is generated from the power of our Sun, either directly into electricity from photons by way of photovoltaic (PV) technology or by capturing the energy from the heat that is generated (i.e., solar thermal). The inherent power of wind is captured by turbines with blades, essentially transferring the energy into mechanical power that generates electricity. Hydropower is the same concept of wind energy applied to the inherent power of water, generating electricity by capturing the energy of moving water through turbines. Geothermal captures the internal energy of the Earth by either generating electricity through turbines or utilizing heat displacement to heat and cool structures. Biomass generates energy in the form of combustibles, to be utilized as a means for creating electricity or as a substitute for transportation fuels.

These alternative energy sources are considered renewable because of their sustainable nature. Unlike carbon-based energy sources, renewable energy sources are endless and, with the exception of biomass, do not produce harmful emissions. Transitioning from carbon-based energy sources to renewables is not as burdensome as the majority of Americans might think. For the most part infrastructure already exists; the trick lies in the responsible implementation of renewables. Beyond the location-based nature of renewables

is the matching or combination of renewables for optimal capitalization that will push them as a viable replacement for carbon-based energy. To further understand the TCE, it is necessary to explore the extraction, production, and consumption consequences of carbon-based energy.

Unfortunately, the economic effects of these energy related incidences are one of the means for these negligent accidents gaining recognition either through the actual loss of oil or impact to local tourist economies. Note that these are not the only isolated events, but simply examples of tragedies that gained extensive media coverage. The environmental effects of such are widely unknown, but greatly feared by academic scholars worldwide and environmental advocates alike. Immediate effects seen in the surrounding wildlife and coastal environments are usually the only ramifications understood by the public. The longer and more far-reaching effects to multiple complex systems of nature are rarely understood outside the world of academia and environmental activism. The production process of oil generates a series of products that are crucial to the transportation, appliance, electronics, and consumer goods industries. Subsequently the production of these products produces harmful byproducts to the environment that are often released into the environment in an irresponsible manner. The consumption of oil, many through the transportation fuels, emits mass amounts of carbon dioxide (CO_2) and is primarily responsible for GCC effects, including increasing greenhouse effects, melting of freshwater reserves (e.g. ice shelf's and glaciers), changing of extreme weather events (e.g. Hurricane Katrina), changes in animal and plant migration, mating, behavioral, and extinction patterns, and the expansion of invasive insects and diseases (Simon 2007).

Coal has very similar economic, social, and environmental impacts to that of oil. The extraction of coal is a very intensive process that is taxing on both the communities and environments that surround operations. The two major methods of mining coal are through shafts or by way of Mountain Top Removal (MTR). Mining through shafts are the dominant historical and iconic method of extraction, whereby miners enter the mountain through digging shafts by which they extract the coal. This is a very dangerous method for miners due to either black lung or collapsing shafts. There have been several coal mining accidents throughout history, including the recently covered events of the 2006 Sago disaster and 2010 Upper Big Branch disaster, both located in West Virginia.

MTR is a method whereby explosives are used to literally blow the tops of the mountains off, pushing the rubble into the adjacent valleys, extracting the coal, and then leveling off the remaining mountain, leaving a barren wasteland that drastically changes the natural landscape. Coal mining is a traditional method of economic livelihood in many Appalachian Mountain communities and hence becomes a dual crisis issue close to the hearts of all the Appalachian people and dividing communities: continue to mine coal while destroying the environment they and generations before them call home and reap decreasing economic benefits, or cease mining to save the environment at the sacrifice of losing the economic impact of the industry.

The small mining communities are severely taken advantage of by the mining companies, who pull out and leave the communities with the ravages of the trade, essentially drastically changing natural environments and devastating any means for economic development. The production of the coal also includes a cleansing process, where toxic chemicals are used to wash the coal before being shipped off as a product. These byproducts

are known as slurry and coal ash. These byproducts are usually housed in huge pits known as slurry ponds, destructed valleys and tributaries covered up with MTR rubble, often dangerously placed above the mining communities or water ways. More often than not these toxic chemical byproducts leach into and contaminate the water sources, effectively killing any remaining wildlife and poisoning local residents, affecting their well-being and increasing healthcare costs. Note that the water sources in these mountains are the headwaters for larger metropolitan communities at lower elevations. Issues of extreme poverty and desperate people exist in the heart of the US. These issues are not isolated to the Appalachian Mountains, they are prevalent anywhere coal mining is operational and even affect the Native American communities often without any coverage from major media outlets. A large portion of our electricity is generated by steam turbines powered from coal-fired power plants. These power plants emit tremendous amounts of CO_2, contributing to the GCC problem facing the world (Bonds et al. 2009).

Both natural gas and nuclear energy have hidden cost issues associated with extraction, production, and consumption. For example, major issues with extracting natural gas from pockets include the displacement of earth causing sink holes, health related problems for local residents ensuing from contaminated drinking water, and property right issues from leasing land to natural gas companies (Fox 2010). Sink holes are also issues related to the effects of extracting coal and oil, leaving cavities that can potentially collapse. Nuclear power is an amazing testimony to the innovative nature of human beings but is just as much a testimony to the dangers of a good intention by the development and use of nuclear power in both the nuclear and hydrogen bombs. Nuclear reactions are powered by uranium and plutonium, making it technically a depleting energy since these elements are

finite. The waste generated from nuclear energy is extremely toxic and hazardous, if not fully understood, to human life, flora and fauna. Prominent examples of failures that strike fear in the hearts of millions and create doubt in total security includes the 1957 Ural Mountains, the 1979 Three Mile Island, and the 1986 Chernobyl accidents. The military applications of nuclear energy essentially make all nuclear power plants national security concerns as ticking time bombs in regards to potential homeland terrorists' attacks. Although effective and efficiently run nuclear power plants should theoretically produce little to no atmospheric emissions, there are the undeniable effects of radioactive/toxic waste management and the effects of thermal emissions from cool-down water entering back into waterways and its effects on local aquatic ecosystems. It is important to understand that these and many more costs are burdens to all other countries across the globe, especially the developing countries and communities that go without the energy sources, the infrastructure that they build, and all of the conveniences that come with them.

CLUSTERS

By exploring the theory of spatial agglomeration, this research attempts to understand how and why the CEE clusters of WNC form. By identifying the attributes and theoretical underpinnings of WNC's particularities of place, the clusters of specialized knowledge and social capital begin to take shape. Alfred Marshall's and Michael Porter's theories of agglomeration provide the foundation of the case studies of defined as learning region clusters (Mackinnon and Cumbers 2007). Marshall's theory is based around the concept of minimizing cost in three aspects: specialized inputs or growths of various industries, development of a specialized pool of skilled labor, and the establishment of a dedicated infrastructure and other collective resources (Mackinnon and Cumbers 2007). This is a

central aspect to the research by analyzing the potential of WNC clusters and collective resources. Idealistic frameworks for the CEE may be evident in the growth of clean energy markets in Asheville, Boone's role of providing a specialized pool of labor, and Lenoir / Hickory's established manufacturing infrastructure.

Porter's theory is focused more on the business aspect of clusters and concludes that they are the result of innovation and learning processes that add value to local communities, specialized markets, and society as a whole (Mackinnon and Cumbers 2007). Each of the study areas includes this aspect as well, contributing its own unique qualities of innovation through learning processes and economic development opportunities. In regards to cluster composition, this research has identified four major components of proximity to utilize as determining factors of clusters: innovation (i.e., specialized knowledge), competition, particularities of place (i.e., uniqueness), and social networks.

INNOVATION

Particularly important to this research are the concepts of innovation and specialized knowledge as it refers to the controversial sources of clean energy economic production. For the case of WNC, there are believed to be various clusters in different vital components of economic development that are based on these concepts. As intuitive and natural as renewable energies may be, they are considered to be knowledge-based economies in conflict with the mechanisms of our established society based on the use of fossil fuel energy sources. Learning regions are hence crucial and play an important role by stimulating the development of economies through interaction with innovative mechanisms in the forms of policy, entrepreneurs, or learning institutions. Learning regions serve as a means of experimenting with the different innovative functions previously mentioned. "These learning

Table 2. From Mass Production to Learning Regions. *Source*: Florida 1995.

	Mass production region	Learning region
Basis of competitiveness	Comparative advantage based on: •Natural resources •Physical labor	Sustainable advantage based on: •Knowledge creation •Continuous improvement
Production system	Mass production •Physical labor as source of value •Separation of innovation and production	Knowledge-based production •Continuous creation •Knowledge as source of value •Synthesis of innovation and production
Manufacturing infrastructure	Arm's length supplier relations	Firm networks and supplier systems as source of innovation
Human infrastructure	•Low-skill low-cost labor •Taylorist work force •Taylorist education and training	•Knowledge workers •Continuous improvement of human resources •Continuous education and training
Physical and communication infrastructure	Domestically oriented physical infrastructure	•Globally oriented physical and communication infrastructure •Electronic data exchange
Industrial governance system	•Adversarial relationships •Command and control regulatory framework	•Mutually dependent relationships •Network organization •Flexible regulatory framework

regions function as collectors and repositories of knowledge and ideas, and provide the underlying environment or infrastructure which facilitates the flow of knowledge, ideas and learning" (Florida 1995, 527). Innovation and specialized knowledge are therefore considered crucial elements of cluster attributes (Table 2) and are foundational frameworks of this research based on identifying the potential of the CEE in WNC.

A crucial and pivotal concept of this research is validated through Mackinnon and Cumbers review of numerous works indicating that innovation and learning are products of geographical proximity (2007). Concepts that provide good examples of this phenomenon are that of tacit and codified knowledge dissemination. "Tacit knowledge is intangible and must be learned at a specific location through direct contact and interaction, in contrast to codified

knowledge that can be transferred through static means such as text; tacit knowledge remains local and geographically *sticky* whereas codified can transcend space and time" (Mackinnon and Cumbers 2007, 242). This key concept is reinforced in the following chapters through case studies that illustrate the connection of competitive advantages to areas that possess abilities to develop and disseminate tacit knowledge. Crucial to the establishment of successfully functioning social networks of the study area's are the entrepreneurial community partnerships with learning institutions (Maskell 2000).

COMPETITION

The foundational economic importance of clusters in capitalist societies' structures is rooted in the concept of competition. This can come in various forms but is connected to the three other concepts included in this section (e.g. innovation, networks, and place), all a part of competition in their own way. Innovation is in its own right a form of competition, providing an edge in a competitive market. Networks provide a means for competition to fluidly move through community communications, effectively the ebb and flow of social dynamics. These concepts are generally place-based, dependent on a location for the accumulation of the attributes of clusters and allowing for a geographic uniqueness to unite specialized market shares or commodities and generate competitive advantages. Competition can be achieved through policy, economy, and environment.

Drawing from innovation, competition is inevitably linked to the concept of developing new ways to approach pressing issues and market them to an economic commodity that is desirable and of worth. As related to the CEE this is of the utmost importance in generating economic development opportunities that can compete with contemporary means of energy production and supplement economic activity in other

connected sectors that have recently suffered due to a culmination of growing globalization and economic recession.

In the Appalachian region it has been well documented that regulation plays an important role in developing clusters, affecting both the economic drivers of businesses and the communities they inhabit through competitive standards. As mentioned in previous sections, fossil fuel industries have taken advantage of influencing policy and regulation, effectively manipulating competition to their advantage. Hence, policy and regulation continue to be a huge barrier to entry for industries that comprise the CEE. The energy sector is influenced by large organizations with established infrastructure and strong ties to Capitol Hill, where regulation is developed to favor fossil fuel advocates and connected industries.

Morgan questioned if regional policy is enough to address the social-economic problems of old industrial regions and can be answered with a definite concern regarding the CEE (1997). This will, of course, require implementation through regulation of the energy sector and allow for the transition into an era of clean energy, effectively opening up an entire market for smaller region-based local economies to compete with larger industry-connected globalized economies. The success of clusters in competitive environments has been identified and documented through Saxenian's research, verifying competitive advantages through innovative horizontal networks and structures exemplified in the successes of Silicon Valley and the erosion of Route 12 (1994). This example of successful clusters with innovative measures calls into question the framework of utilizing dynamic networks.

NETWORKS

The social component of network dynamics is a crucial aspect of identifying and understanding cluster functions pertaining to the scope of this research. Networks can be ambiguous and elusive in nature, as they tend to be dynamic and constantly changing or evolving. Elements of trust, local buzz, flexibility and untraded interdependencies are often difficult to measure and able to influence particular networks. Clusters are held together by the social capital of networks and prove to play a still undetermined role in academic, professional, and business understanding of cluster functions (Lombardi 2003). Networks play a functional role in the dynamics of organizations and the guiding operations of how business is carried out or how the transparency and access of the public welfare are applied to pressing issues either through vertical or horizontal structures. Social capital in essence is the raw resource that networks derive from; whether comprised of entrepreneurs, scholars, or government officials, these pools of talent are organized and act in unity towards a common goal to achieve a task.

Two major works have influenced this research focus on networks in their analysis of the importance they play in success of clusters. Henry and Pinch's work identifies key actors (Figure 3) in the churning of specialized knowledge of Motor Valley and trace individuals' career paths (2000). "In the contemporary world of the knowledge economy, understanding the spatial organization of knowledge production, process of knowledge generation and dissemination is critical to the constitution of the knowledge community and has become a key issue in identifying geographically-concentrated nodes of knowledge production" (Henry and Pinch 2000, 191-192). Saxenian's work in *Regional Advantage: Culture and Competition in Silicon Valley and Route 128* analyzes the attributes of both

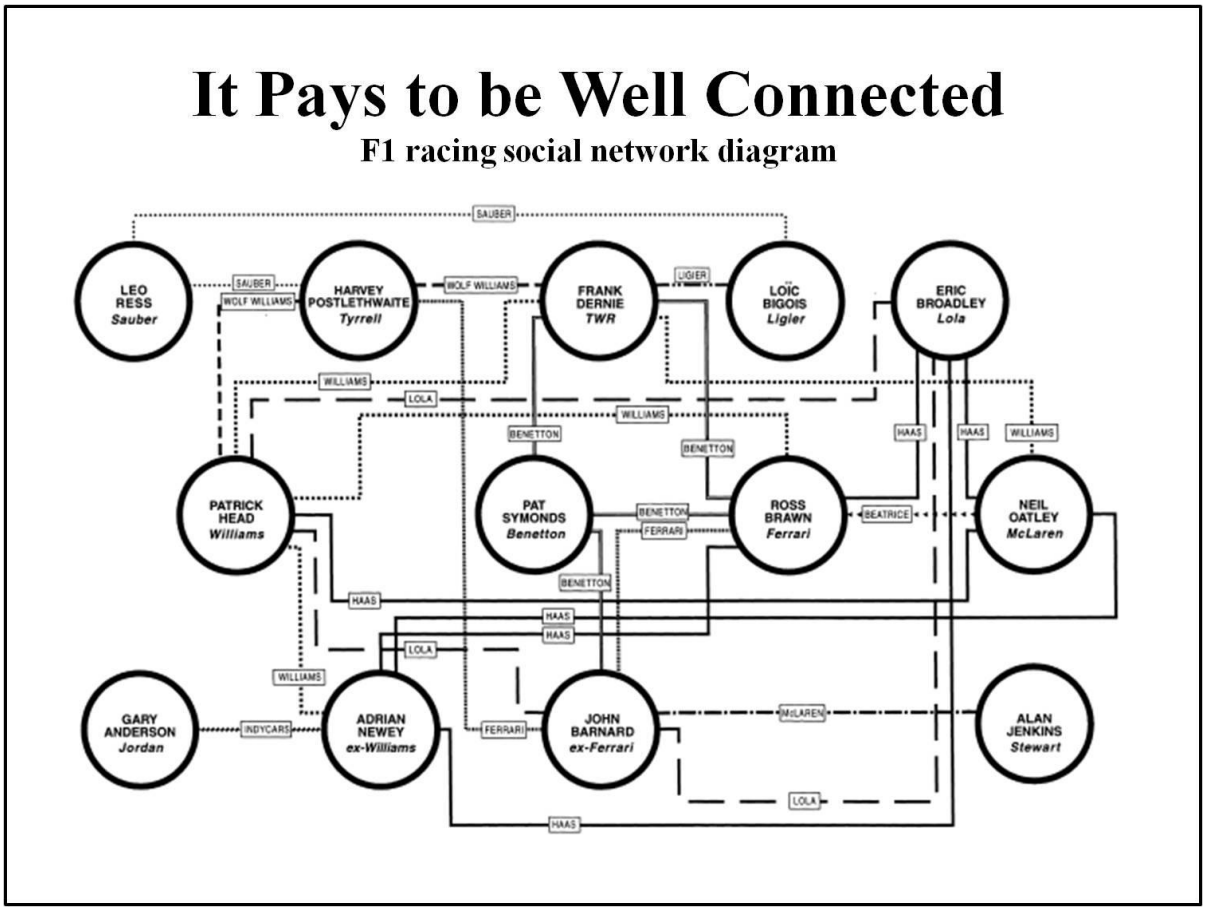


Figure 3. It Pays to be Well Connected. *Source*: Henry and Pinch 2000.

social networks of communities in Silicon Valley and Route 128, identifying how elements of Silicon Valley's networks became successful and eventually out-performed Route 128 through repeated interaction and build up of mutual trusts (1994). These two works are central in understanding the importance of networks with all their intangible elements such as trust, local buzz, flexibility and untraded interdependences. "Trust is crucial in maintaining a constant flow of knowledge among organizations, firms, and industries by allowing each member to effectively communicate and adapt to changing situations or fluctuations in the market" (Morgan 1997, 501).

Universities and industry help to shape policy specifically for regions, connecting the people of an area with the ideas that define them and their livelihood to the policy that drives

their economies (Messer and Kecskes 2009). These types of networks are evident in the WNC region, connecting the needs of the population to demands and behaviors or beliefs. The social capital of the CEE in WNC is a unique resource because the region seems to be united in preserving its environment, promoting equality, and developing its own economy. According to Maskell and Malmberg, social capital refers to "the values and beliefs that citizens share in their everyday dealings which give meaning and provide design for rules, accumulating within the community through processes of interaction and learning that influence a community's long-term economic performance" (1999, 119-120). O'Brien argues that with the advancement of technology there has come an end to geography, but this is not the case with WNC in regards to the CEE where tacit knowledge plays a crucial role in the production of knowledge and the development of the clusters and their functioning networks, which organize power from constant sharing of information (1992).

PLACE

The particularities of place are often underappreciated or discounted altogether as an asset, an attribute of equal value that holds importance in the development and success of clusters. Heritage and culture are generally thought of as the driving forces that make up particularities of place, but every locality is different in one way in another through a combination of its physical geography, infrastructure, socio-economic and socio-political compositions that make the area unique – in essence the particularities of the place. The WNC region is located in the Appalachian Mountain Range and nurtures a unique culture and heritage that thrives because of the remote nature of the region and connectivity to the physical environment, prompting residents of these communities to favor local businesses and support local economies.

The uniqueness of the study areas may offer specialized inputs or growth of the various industries in the CEE through the partnerships between the networks of learning institutions, industry, and community-based organizations rooted in environmentally sound economic development initiatives closely linked to sustainability. The development of a specialized pool of skilled labor is evident in learning institutions and non-profit organizations in each of the study areas, including Appalachian State University (ASU), Warren Wilson College (WWC), and Caldwell Community College and Technical Institute (CCCTI) to name a few. The establishment of dedicated infrastructure and other collective resources is also evident in the learning institutions, existing manufacturing facilities, and growing development of renewable energy technology, and is reinforced by the networks of the CEE. Entrepreneurs of the study areas play crucial roles in ensuring the uniqueness of the region by carrying on the tradition of the culture and heritage of the region by constantly seeking out innovative means of solving pressing issues.

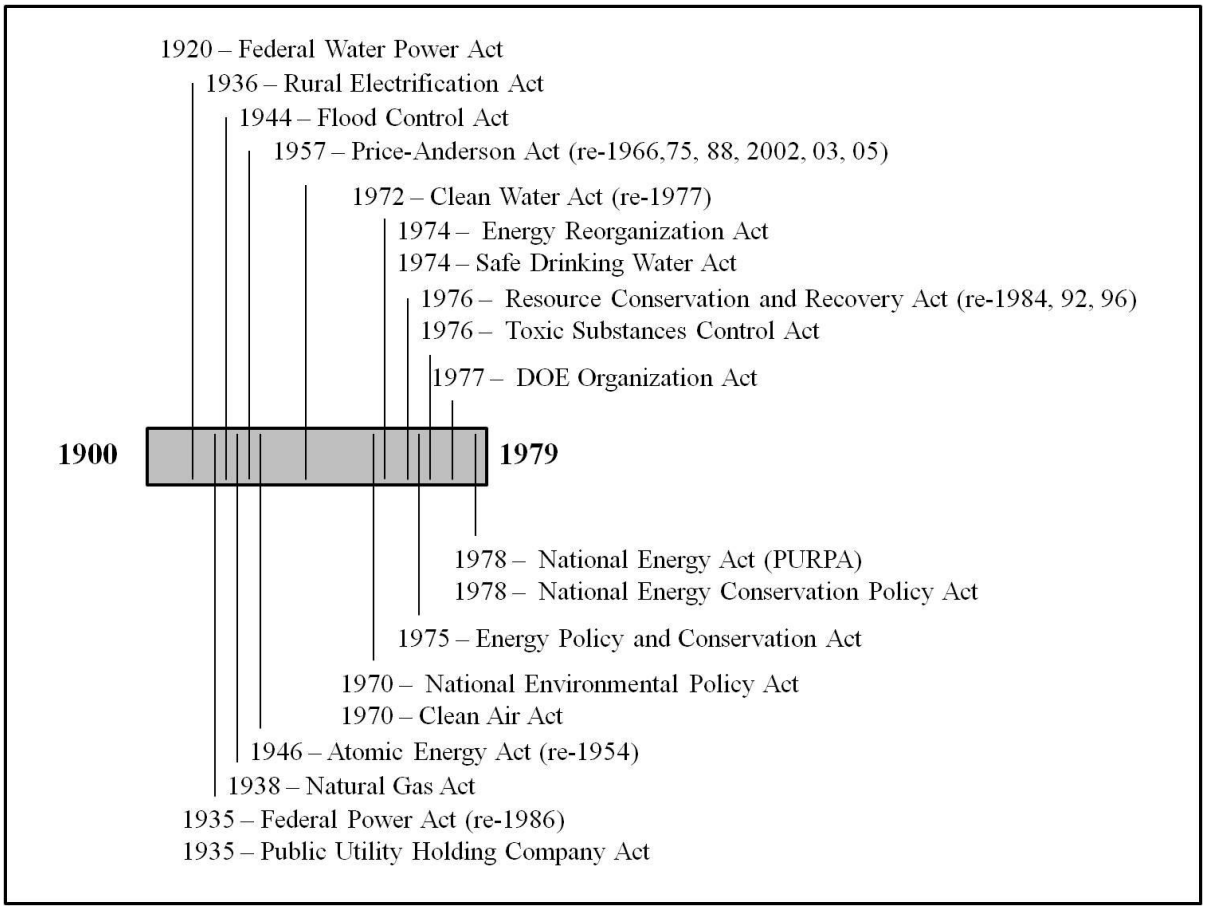
CHAPTER 3 – ENERGY POLICY ANALYSIS

This section examines energy policy and its application at different scales. Federal energy policy from the previous section will be expounded upon as key legislation that has set the foundation for how the US administers energy issues on a national scale. Crucial to understanding the regional implications of energy issues, regional policy will be reviewed from scales that reach between several states to sections of states (i.e., Appalachian region). North Carolina state energy policies will be examined to determine what legislation and regulation affects the development of WNC sustainability efforts. Incentives to promote EERE will be explored as an additional element of innovative policy function. The culmination of exploring these various scales of policy will establish a dynamic framework of the energy legislation and regulation landscape in WNC.

FEDERAL POLICY

Federal policy is often known for functioning via top-down methods, particularly in energy policy. With the establishment of Federal policy such as the PURPA, the creation of the Federal Energy Regulatory Commission (FERC), and the DOE, US federal policy has taken great strides in regulating national energy demands and supply of established infrastructure and continues to work towards developing additional policy to adapt to the approaching depletion of fossil fuel energy sources (Tables 3 and 4). For example, top-down legislation in the form of the EPAct and EISA has led to “integrative Federal energy management requirements in several areas that include energy reduction goals for Federal

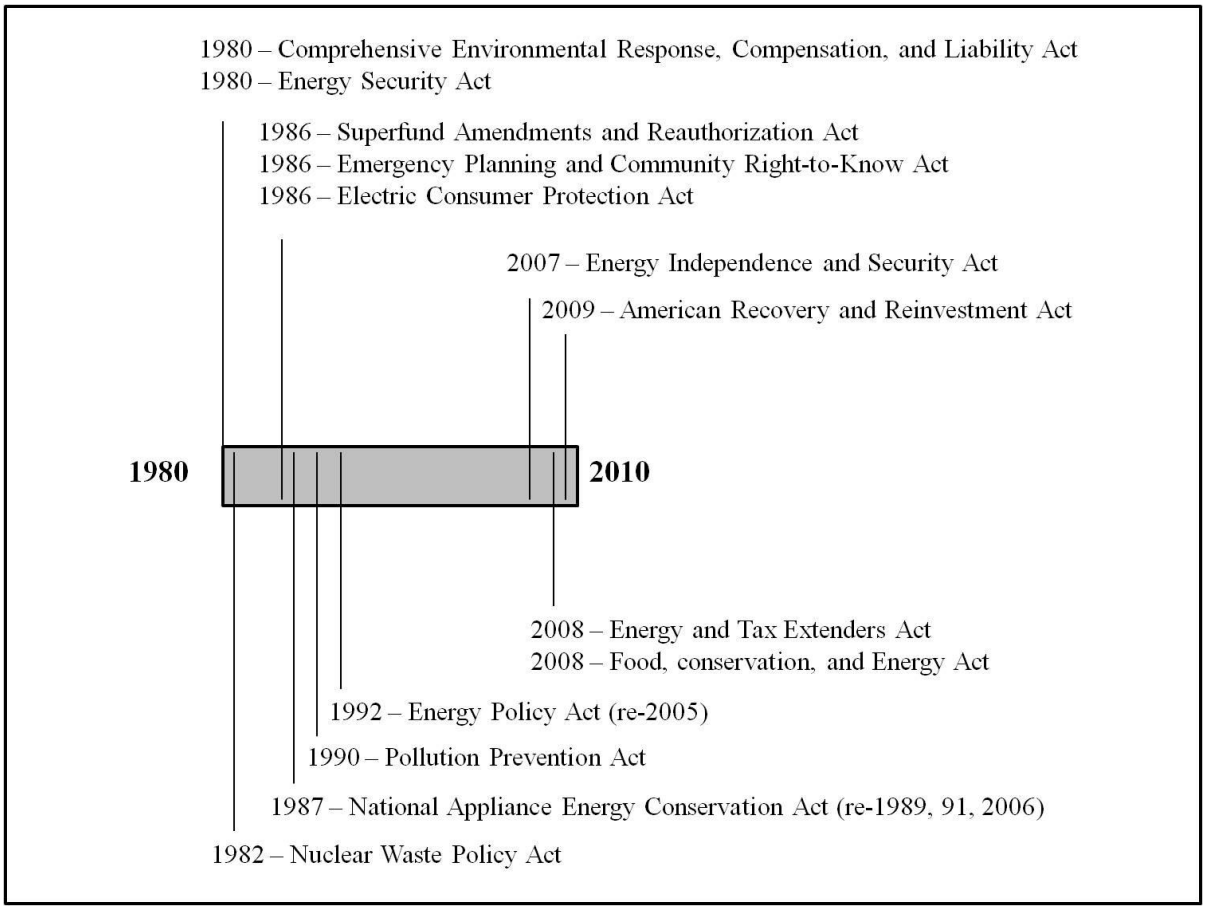
Table 3. Federal Energy Policy Timeline 1900-1979. *Sources*: Data from DOE-Energy Policy 2009; FERC 2009.



buildings, facility benchmarking, performance and standards for new building and major renovations, energy performance contracts, and net metering as defined through the Leadership in Energy and Environmental Design (LEED) rating systems to effectively reduce petroleum use by 2% every year" (U.S. Department of Energy – Federal Energy Management Program 2010). Another example is found in the American Recovery and Reinvestment Act (ARRA) which focused on modernizing the "nation's energy infrastructure, enhancing energy independence, and expanding energy educational and employment opportunities" (U.S. Department of Energy - Recovery and Reinvestment 2010).

Federal energy policy is built upon previous legislation and enforced through US agencies and departments such as the DOE, Environmental Protection Agency (EPA), the

Table 4. Federal Energy Policy Timeline 1980-2010. *Sources*: Data from DOE-Energy Policy 2009; FERC 2009.

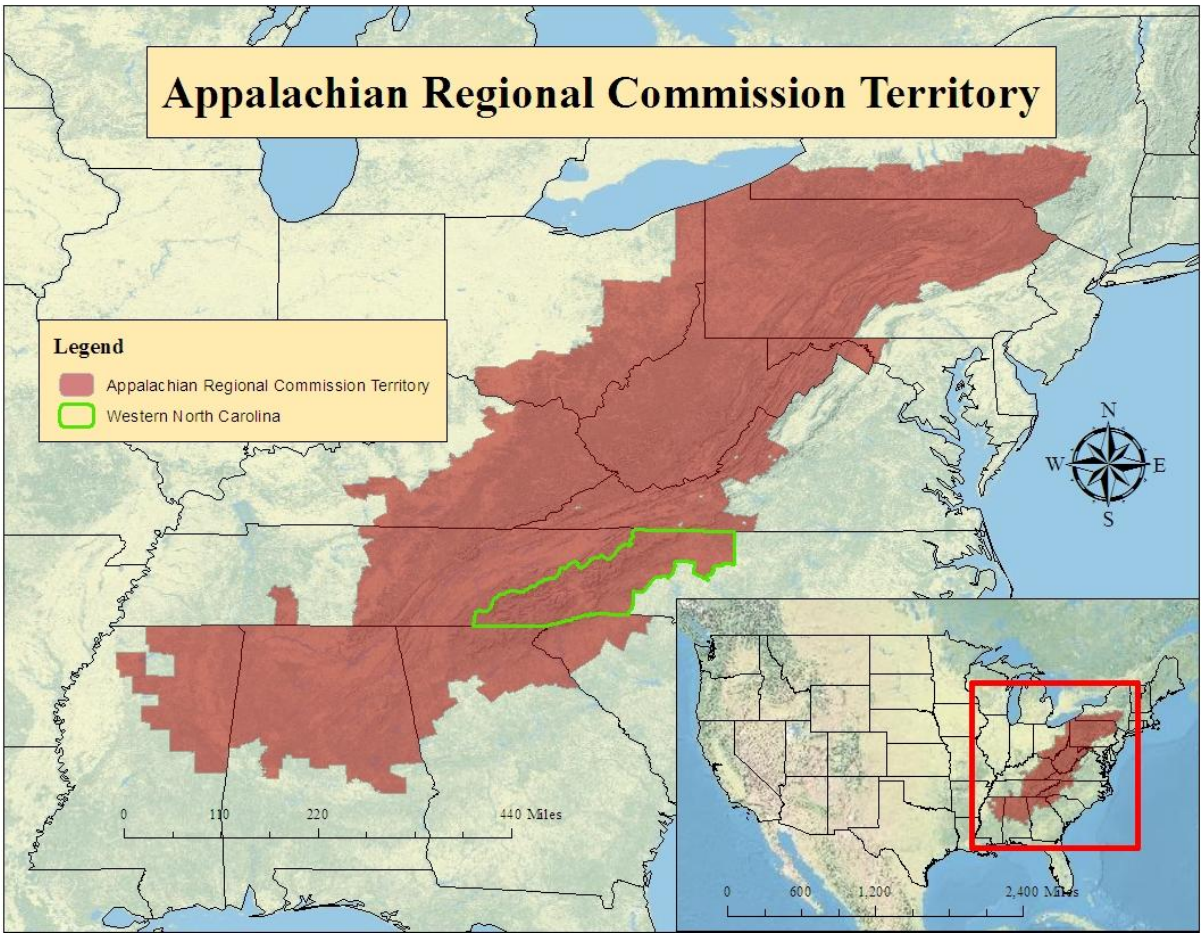


US Department of Agriculture (USDA), the Department of Housing and Urban Development (HUD), and the US Army Corps of Engineers (USACE). The DOE plays a central role by acting as a regulatory agency and standard-setting department. The DOE Office of EERE is charged to oversee several programs that push progressive energy policy including financial assistance, education, and behavioral impacts through standard-setting and sponsorship of commercialization research and implementation. The Office of the EERE operated with a $2.2 billion budget in 2009 spent on "solicitations, grants, cooperative agreements, awards, loan guarantee programs, and contracts to states, industries, universities, businesses, and consumers." (U.S. Department of Energy Office of Energy Efficiency & Renewable Energy - Funding and Award Process 2009). Another example is found in the ENERGY STAR

program, “a joint venture between the DOE and EPA to assist consumers and businesses in reducing energy consumption through the use of appliances and in 2009 saved enough energy to power 10 million homes, equating to roughly $6 million” (U.S. Department of Energy - ENERGY STAR 2010). Overall the public can benefit from DOE programs in the form of “tax credits, grants, rebates, energy efficiency mortgages and financing, and even assistance for low income families through the Weatherization Assistance and Intergovernmental Program which operates $3.1 billion in funds through the ARRA” (U.S. Department of Energy Office of Energy Efficiency and Renewable Energy - Financial Opportunities for Consumers 2009). In partnership with previously mentioned federal agencies, national associations, special interest groups, and private contractors, the DOE approaches energy policy via top-down mechanisms to improve standards and regulations in residential, commercial, and industrial settings.

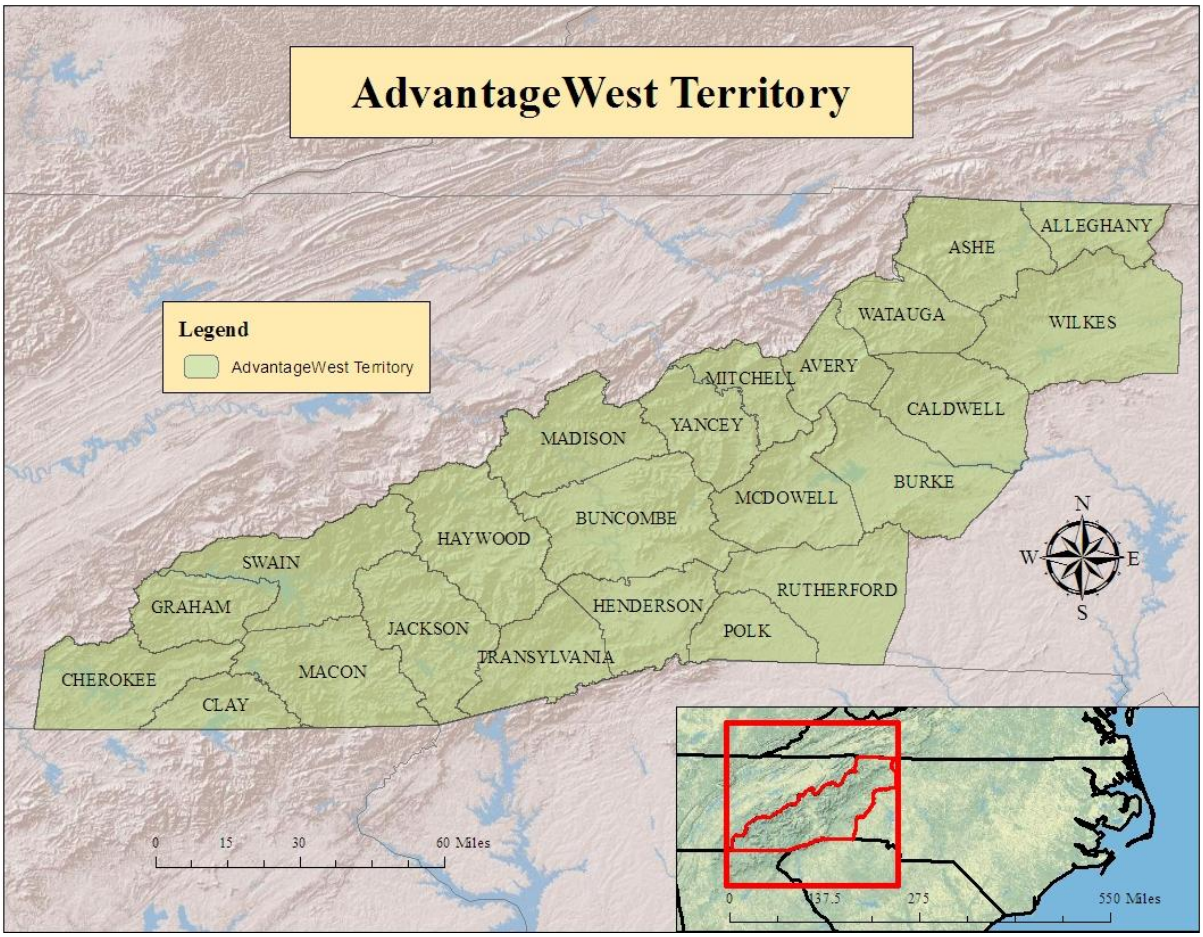
REGIONAL POLICY

Regional policy, much like federal policy, has also traditionally been carried out in the top-down method and serves as a model for areas linked through cultural and physical commonalities. The Appalachian Mountains share a unique culture dispersed throughout its region and mainly consisting of remotely isolated rural areas within the mountains. The scope of this research is found in the area located within the Appalachian region of WNC, an area with economic development support from the Appalachian Regional Commission (Map 2). “The Appalachian Regional Commission (ARC) is a federally mandated regional economic development agency that fosters strategic partnerships between Federal, the thirteen consisting states, and their local governments to implement regional development policy and programs designed to advocate for sustainable communities in Appalachia”



Map 2. Appalachian Regional Commission Territory. *Source*: Data from ARC – Program Areas 2010; ARC – The Appalachian Region 2010.

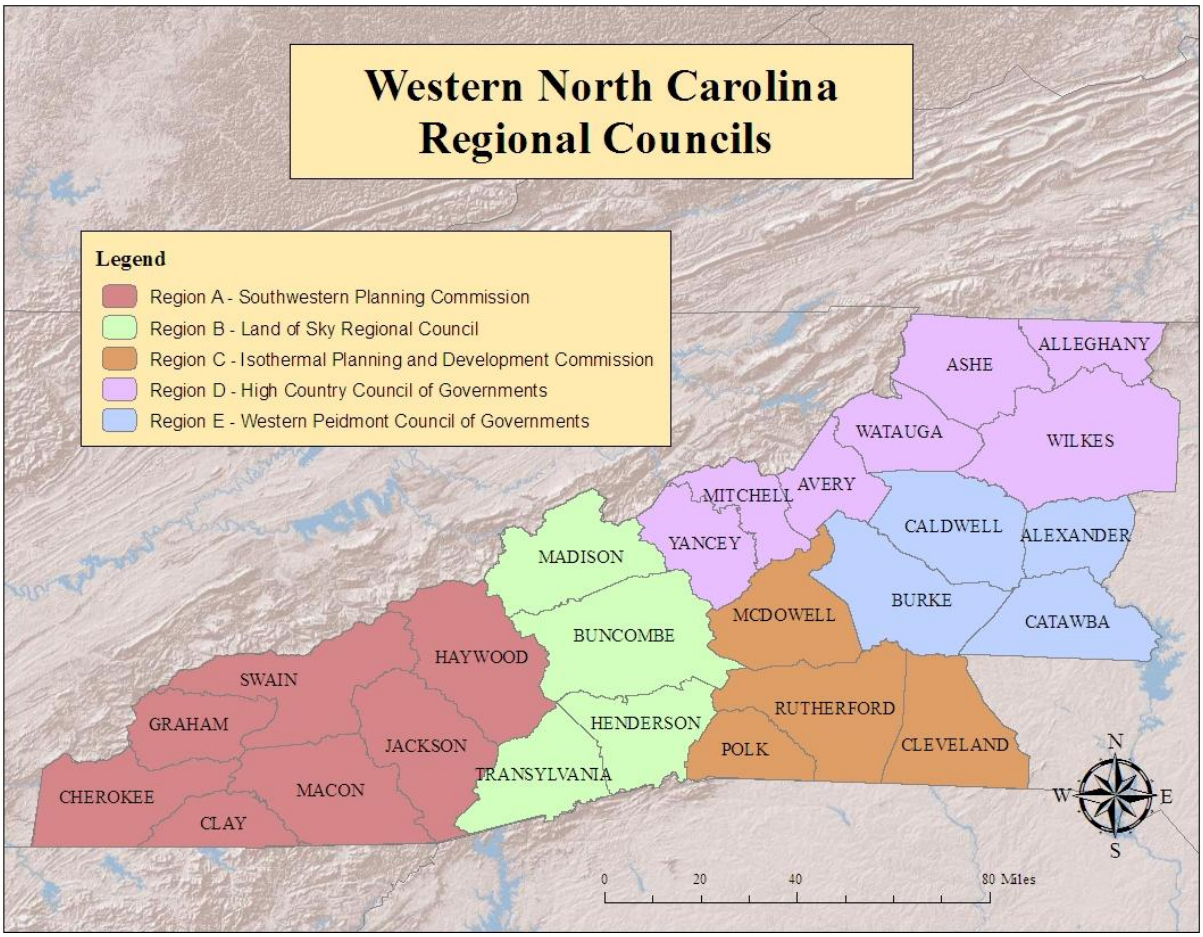
(Appalachian Regional Commission - About ARC 2010). Various reports and research conducted by or contracted out for the ARC over energy issues conclude that the Appalachian area holds high potential, approximately 33% better than national averages, for competing in renewable energy industries and development of sustainable infrastructure to meet projected increased energy consumption (Marshall University Center for Business and Economic Research 2006). Research conducted by Glasmeier et al. has revealed some of the most useful information indicating status and behavior of industries, how domestic manufacturers and installers might engage the sector, and regional indications of competition



Map 3. AdvantageWest Territory. *Source*: Data from AdvantageWest - Our Region 2006.

in these rapidly emerging global economies (Glasmeier and Bell 2006; Glasmeier et al. 2007; Susman and Glasmeier 2009).

Regional policy can also apply to state and local level agencies and organizations that operate by either bottom-up or horizontal methods. In WNC there are primarily three influential and progressive economic development groups that utilize networks of local partnerships to foster the development of sustainable communities: AdvantageWest, North Carolina Regional Councils, and Land-of-Sky Regional Council. AdvantageWest is the regional development partnership serving twenty-three counties of WNC (Map 3) and focusing on "growing the WNC economy around ten identified clusters of innovation for which strong university and commercial capabilities and assets are already in place in the



Map 4. Western North Carolina Regional Councils. *Source*: Data from North Carolina Regional Councils 2006.

region that include concentrations of companies or industries connected by markets they serve" (AdvantageWest - Our Region 2006). In particular, AdvantageWest has established the "Advantage Green program aimed to leverage regional strengths to promote green economic opportunities and to support long term green job creation and retention throughout WNC" (AdvantageWest - Advantage Green 2006).

The North Carolina Regional Councils also play an important role in the development of the WNC region through their collaborations with localized county and city governments in sub-regions of WNC. Of the seventeen statewide multi-county planning and development councils, WNC has five (Region A – Southwestern Commission, Region B – Land-of-Sky Regional Council, Region C – Isothermal Planning and Developing Commission, Region D –

North Carolina High Country Council of Governments, and Region E – Western Piedmont Council of Governments). Each council's function is to improve strategies, operations, and capabilities of local governments (Map 4). The regional councils resulted from state legislation enacted in 1968 and engage in a number of activities supporting local planning agencies. For example, the Land-of-Sky Regional Council supports "the Regional Strategic Fuel Project that plans for economic and emergency service disruptions caused by fuel shortages in WNC and the innovative Building the CEE in WNC project designed to facilitate business activity and enhance the visibility of the clean energy sector, thereby creating jobs, recruiting new businesses and adding value to the existing cluster of clean energy businesses in rural North Carolina" (Land-of-Sky Regional Council 2010).

STATE AND LOCAL POLICY

State policy can be carried out through both top-down and bottom-up methods. In the state of North Carolina, both methodologies carry equal weight of importance in addressing challenges of implementing a sustainable economy. North Carolina is one of the nation's most progressive states to implement legislation and establish programs and initiatives towards developing its CEE, proving to be a leader among states in the southeast (Table 5). In 2007, North Carolina passed Senate Bill 3, otherwise known as the North Carolina Renewable Energy and Energy Efficiency Portfolio Standard, that required utility companies to provide a percentage of its electricity from eligible renewable sources (investor-owned to supply 12.5% by 2020 and municipal-owned to supply 10% by 2018) and a supplemental phase-in of energy efficiency technology to be counted up to 40% of standards by 2021" (Database of State Incentives for Renewables and Efficiency - North Carolina Rules,

Table 5. DSIRE North Carolina Rules, Regulations, and Policies. *Source*: Data from DSIRE 2010.

Building Energy Code
Energy Standards for Public Buildings
- •Conservation of Energy and Water Use in State Buildings
- •City of Asheville – Efficiency Standards for City Buildings
- •Durham County – High-Performance Building Policy
- •Town of Chapel Hill – Energy Conservation Requirements for Town Buildings

Interconnection Standards
Net Metering
Renewables Portfolio Standard
- •Renewable Energy and Energy Efficiency Portfolio Standard

Solar/Wind Access Policy
- •Solar Rights
- •Town of Chapel Hill – Land-Use Management Ordinance

Solar/Wind Permitting Standards
- •Ashe County – Wind Energy System Ordinance
- •Camden County – Wind Energy System Ordinance
- •Carteret County – Wind Energy System Ordinance
- •Currituck County – Wind Energy System Ordinance
- •Hyde County – Wind Energy Facility Ordinance
- •Madison County – Wind Energy System Ordinance
- •Model Wind Ordinance
- •Pitt County – Wind Energy System Ordinance
- •Town of Kill Devil Hills – Wind Energy System Ordinance
- •Tyrrell County - Wind Energy Facility Ordinance
- •Watauga county - Wind Energy System Ordinance

Regulations, and Policies: Renewable Energy and Energy Efficiency Portfolio Standard 2010).

The North Carolina Utilities Commission (NCUC) adopted a portfolio standard in 2008 opening up the "market for Renewable Energy Credits (RECs) and establishing the policy as one of the most influential legislative acts towards developing the clean energy market" (North Carolina Utilities Commission 2010). The NCUC also adopted interconnection requiring the state's investor-owned utilities to offer net metering to customers that own and operate electricity generating systems such as renewable energy systems (Database of State Incentives for Renewables and Efficiency – North Carolina Rules, Regulations, and Policy: Interconnection Standards 2010). The NCUC also adopted

the North Carolina Renewable Energy Tracking System in 2010 to ensure the proper accountability of REC's as mandated by Senate Bill 90. North Carolina also passed Senate Bills 668 and 1946 to promote conservation in state buildings (Database of State Incentives for Renewables and Efficiency – Conservation of Energy and Water in State Buildings 2010). The state also implemented a new State Building Energy Code in 2008 to increase energy efficient technology and practices in new buildings (Database of State Incentives for Renewables and Efficiency – North Carolina State Building Codes 2010). Finally, the North Carolina Wind Working Group (NCWWG) created the North Carolina Model Wind Ordinance (NCMWO) in 2008 for local municipalities to assist with the implementation of wind turbines primarily in the western North Carolina region (Database of State Incentives for Renewables and Efficiency – North Carolina Rules, Regulations, and Policies: North Carolina Model Wind Ordinance 2010).

In 1998, the state of North Carolina issued Executive Order 156 launching the North Carolina Project Green (NCPG) that issued the challenge for State governments to tackle environmentally friendly and energy efficiency projects. To the surprise of everyone, most local governments were already involved in such projects. For example, the North Carolina State Energy Office (NCSEO) operates several programs such as the Waste Reduction Partners program, Clean Cities program, and North Carolina Building Training Certificate programs designed to develop the CEE (North Carolina Department of Commerce 2008).

INCENTIVES

A crucial aspect of implementing and promoting the mechanisms of CEE infrastructure, economic development, and policy is through incentives. Factors limiting implementation of sustainable projects are often related to initial start-up costs. In an effort to

Table 6. DSIRE North Carolina Incentives. *Source*: Data from DSIRE 2010.

Corporate Tax Credit	Green Building Incentive
Industry Recruitment / Support	Local Grant Program
Local Loan Program	Local Rebate Program
PACE Financing	Performance-Based Incentive
Personal Tax Credit	Property Tax Incentive
Sales Tax Incentive	State Rebate Program
Utility Loan Program	Utility Rate Discount
Utility Rebate Program	

offset and alleviate these barriers to entry, a series of incentives are offered through federal, regional, state, and local non-profit entities to foster economic development momentum for individuals, businesses, and communities (Table 6). These incentives and opportunities present themselves in several different forms such as networking events, technical expertise, education, certifications and professional development, fast track programs and even funding such as grants, low interest loans, tax credits and deductions.

In addition to the policies mentioned in earlier sections, federal and state departments, programs, and offices also provide incentives to foster economic development. For example, there were "$3.2 billion allocated for the programs that qualify for the Energy Efficiency and Conservation Block Grant Program and $125 million allocated towards Green Collar Job

training programs" (U.S. Department of Energy - Recovery and Reinvestment 2010). The DOE offers incentives including educational and certification programs in connection with the building and manufacturing industries to improve building codes and appliance standards. The USDA also provides grants through the "Natural Resource Conservation Service Stewardship Program that works towards improving energy enhancement through energy audits of agricultural operations, producing and consuming renewable fuels, generating renewable energy, soil tillage, use of nutrient sources, energy use reduction, and recycling" (U.S. Department of Agriculture 2012). The EPA even incentivizes academic programs and institutions to generate innovative awareness approaches to energy-related issues through various grants and competitions such as the P3 (People, Prosperity, and Planet) student design competition.

A unique resource that was developed by state level entities gained investments from federal departments and programs, offering a variety of educational information by serving as a clearinghouse of policy and incentives geared to promote economic development and grow market shares of the clean energy economy. The Database of State Incentives for Renewable and Efficiencies (DSIRE) is one such resource available that informs the public with helpful information about both policies and different types of incentives for implementing EERE technologies and projects. "DSIRE was developed in 1995 by the North Carolina Solar Center and the Interstate Renewable Energy Council as an ongoing project with support and funding from the DOE and NREL" (Database of State Incentives for Renewables and Efficiency - DSIRE Home 2010). As a resource developed to assist end-users with implementation of renewable energy technologies and commercialize the growing CEE, DSIRE serves as a primary example of North Carolina's innovation towards leading

sustainable efforts for the nation. In conjunction with federal incentives, the state of North Carolina provides its own incentives that include tax credits, low-interest loans, grants, and even fast track building permits to jump start reluctant businesses and private enthusiasts. The state funded sources that provide incentives include the North Carolina Board of Science and Technology (NCBST), the North Carolina Department of Environmental and Natural Resources (NCDENR), and the NCSEO.

As mentioned before, non-profits serve as an important part of incentivizing the development of the CEE as state-funded programs with a more grassroots orientation (Table 7). The incentives that come from the non-profit sector include but are not limited to education, networking opportunities, technical expertise, economic development through arts and crafts, and agriculture/horticulture. Organizations that provide educational-oriented services include the Western North Carolina Green Building Council (WNCGBC), Sustainable Western North Carolina (SWNC), and the North Carolina Biofuels Center (NCBC). Financial incentives are available from sources such as the Community Foundation of Western North Carolina (CFWNC), National Capital Investment Fund (NCIF), and the North Carolina Rural Economic Development Center (NCREDC).

Table 7. Government, Non-Profit, and Funding Opportunities. *Source*: Data from North Carolina Department of Commerce 2008.

State Government

- North Carolina Board of Science and Technology – One NC Small Business Fund
- North Carolina Board of Science and Technology – Green Business Fund (Government)
- North Carolina Department of Commerce (Government)
- North Carolina Department of Environmental and Natural Resources
- North Carolina Energy Efficiency Legislation
- North Carolina Energy Utility Legislation and NC Energy Company Grants
- North Carolina Office of Environmental Education
- North Carolina Project Green
- North Carolina Renewable Energy Tax Credits
- North Carolina State Energy Office

Federal Government

- Appalachian Regional Commission
- Green Collar Jobs Act
- Tax Credits for Energy Efficiency
- The U.S. Green Building Council
- USDA – Energy Programs and Funding

Non-Profit

- Asheville Green Opportunity Corps
- Golden LEAF Foundation
- Handmade in America
- Interstate Renewable Energy Council
- Mountain BizWorks
- North Carolina Biofuels Center
- North Carolina Rural Economic Development Center – Sustainable Communities Initiative
- North Carolina Sustainable Energy
- Project Energy Xchange
- Sustainability Institute
- Sustainable North Carolina
- Sustainable Western North Carolina
- Western North Carolina Green Building Council

Other

- Advantage West (Economic Development Commission)
- Blue Ridge Angel Investor Network (Investment Network)
- Self-Help Credit Union (Banking and Lending)
- Natural Capital Investment Fund (Banking and Lending)

Councils of Government

- North Carolina Councils of Government
- Centralina Clean Fuels Program
- Industrial Ecosystems Development Project
- Land of Sky Regional Council
- Region C (Isothermal Planning Council) Brownfields Initiative
- Region D (High Country Council of Governments)
- Region E (Western Piedmont Council of Governments)
- Southwest Commission
- Triangle Clean Cities Coalition

Colleges and Universities

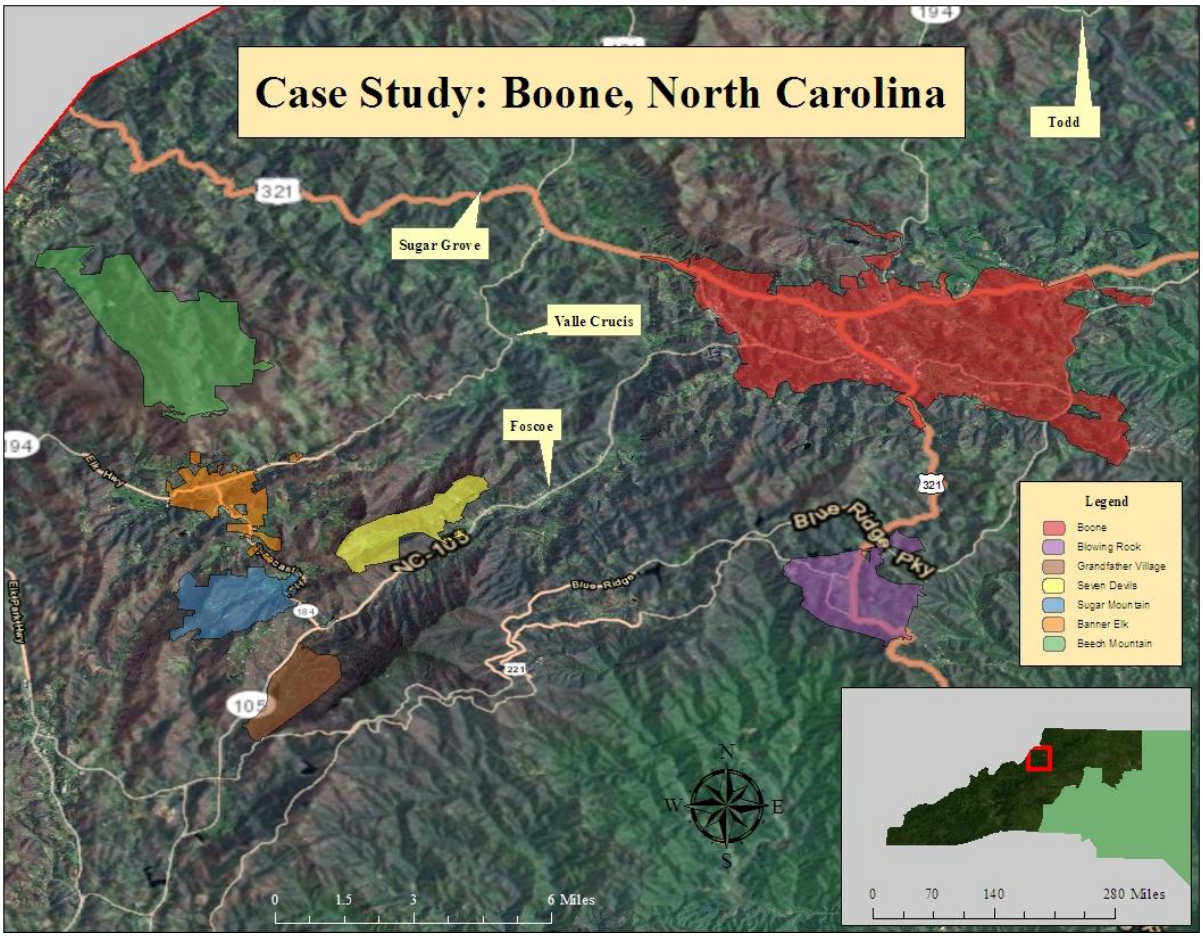
- North Carolina Community College System
- University of North Carolina
- North Carolina Small Business and Technology Development Center (University Project)
- North Carolina State University – Institute for Emerging Issues (University Institute)
- North Carolina Solar Center (University Center)
- North Carolina Wind Energy (University Project)
- Warren Wilson College

CHAPTER 4 - CASE STUDY: BOONE

Figure 4. Boone, North Carolina

GEOGRAPHIC PROFILE

Located in the Northern end of the WNC region, the town of Boone (Figure 4) is the county seat of Watauga. The town of Boone, which rests in a valley overlooked by Howards Knob, was named after the famous pioneer Daniel Boone. Boone is home to the ASU Mountaineers, and is considered to be the heart of the High Country. Boone is located "at an elevation of 3,333 feet (1015.9 meters) above sea level, the highest elevation of any town its size East of the Mississippi River" (Town of Boone, NC 2011). It is also at the intersecting point of Highways 321 (running North/South and then East/West from Boone), 421 (running East/West and then North/South from Boone), and 221 (running Northeast/Southwest) (Map 5). For the purposes of this research the Boone area is defined as the collective local



Map 5. Case Study: Boone, North Carolina.

communities which include Boone, ASU, Banner Elk, Beech Mountain, Blowing Rock, Foscoe, Grandfather Village, Seven Devils, Sugar Grove, Sugar Mountain, Todd, and Valle Crucis. Nestled deep in the Appalachian Mountain Range, the Boone area is home to a cluster of the region's most breathtaking, recognizable, and iconic peaks, escarpments, gorges, vistas, valleys, rivers, streams, and waterfalls. The Boone area is rich with pristine natural beauty and recreational resources as well as the headwaters for both the New River and the Watauga River and in close proximity to the Blue Ridge Parkway, Pisgah, Cherokee, and Jefferson National Forests, and the Appalachian Trail.

Economic indicators of the Boone area are heavily dependent upon the business generated by ASU as found in economic stimulation from students, faculty, staff, and the

growing base of alumni and sports fans. The tourism industry including hospitality and all of its broad avenues based on targeted recreational resources such as skiing, snowboarding, tubing, hiking, camping, rock climbing, canoeing, kayaking, fishing, and seasonal Christmas tree farms are foundation aspects of the local economy. "The Boone area generated an estimated economic impact of $506 million from ASU in 2006, $191 million from tourism in 2007, and an annual impact of $14 million from the seasonal 'choose and cut' Christmas tree industry" (Watauga County Economic Development Commission 2009).

The housing and construction industries are also of great economic importance to the Boone area, particularly related to resurrecting the recent collapse of these industries through the transition to the CEE (i.e. the role of implementing energy conservation methods). "It is estimated that a third of all new building permits in the Boone area are for seasonal housing, that approximately 47% of all properties are absentee-owned, that the area has a below the 2009 national average of per capita income, and above the 2009 national average of individuals below poverty levels" (U.S. Census Bureau - Watauga County, North Carolina 2011). These statistics speak volumes on the importance of housing and construction to the area and raise questions concerning the interrelated issues such as gentrification and its political effect on the local economy. The Town of Boone's current population is estimated to be approximately 15,000, in addition to ASU 2009 enrollment estimated to be approximately 17,000; total Watauga County 2009 population was estimated to be approximately 45,000 (Integrated Postsecondary Education Data System 2009; Town of Boone, NC 2011; U.S. Census Bureau - Watauga County, North Carolina 2011).

"The Boone area's 2009 demographics are predominantly white (95%), approximately equal distribution between male and females, a median age of 27.8, and above

national average of higher education attainment levels, particularly higher in Boone centered around ASU" (U.S. Census Bureau - Watauga County, North Carolina 2011). The Boone area's population is equally split between locals' generations and a constant influx of environmentally conscious individuals drawn to the beauty of the land and its cultural significance. The Boone area offers a quaint and creative culture typical of small Appalachian Mountain towns. Due to the area's reliance upon tourism, it greatly emphasizes and embraces its mountain heritage and culture through producing Appalachian specific arts, crafts, and agricultural products and services strongly influenced by its surrounding geography. The Boone area is prosperous with educational opportunities and an array of community events designed to preserve and disseminate the unique culture through showcasing local artisans and community projects.

The Boone area is also thriving with an embedded entrepreneurial spirit common among the Appalachian people, rooted in the need to create new and innovative means in order to survive with limited resources and infrastructure in the relatively isolated mountainous region. The Boone area is unique in that it attracts individuals who take it upon themselves as a moral responsibility to proactively implement progressive environmental and social equity policies that promote sustainable economic development. These attributes also promote a strong sense of community and can be identified through the cluster of supporting networks of educationally-oriented, environmentally-conscious institutions, organizations, firms, and individuals, and their collective efforts.

SWOT ANALYSIS

STRENGTHS

The Boone area is crucial to the development of the WNC CEE in that it is a major source of generating and disseminating the process of specialized knowledge production. ASU and other local institutions are linked to local organizations and nationally recognized for contributing to the advancement of progressive technology and practices required to transform communities to sustainable lifestyles. Programs offered at ASU, including but not limited to the Appropriate Technology (AT) and Sustainable Development (SD), in conjunction with an array of local community organizations, function in an applied education and outreach capacity thereby providing an ideal situation and definition of a learning region.

The Boone area has a rich history in forging new ground as the forerunner of innovative approaches and bringing such technology to fruition by applying theory to practice. In addition to the innovative programs at ASU the area also essentially serves as a laboratory or application experiment in and of itself. The area's plentiful water source(s) provided several readily-available resources for water mills to power saws for extensive logging and mills during the early 1900's. In the early 1970's the area was introduced to the Carolina Water Stove developed by Henry Gleen as an innovative way to utilize solar energy to heat water and condition living space (Suddreth 2010). From 1972-78 a partnership between DOE, National Aeronautics and Space Administration (NASA), and General Electric produced the US's first commercial wind energy research project, the 200 Kilowatt (kW) MOD-1, to determine the possibility of wind energy in the US, and proved to be a huge

success for the area in attracting more tourists curious about new technology and developing an iconic perspective of the landscape.

The rich history of demonstration projects in connection to the CEE is even further driven by several components of ASU, through applications of innovative specialized knowledge directly responsible for several of its outreach and civic projects of organizations and departments. The students of ASU take great initiative in applying the specialized knowledge they develop; two of the most successful student organizations in driving the CEE include the ASU Sustainable Energy Society (ASUSES) and Renewable Energy Initiative (ASU REI). ASUSES is the University's chapter of the American Solar Energy Society (ASES) that is operated by students and guided by faculty to perform various outreach activities around the region that inform the public about clean energy and sustainable lifestyles through workshops, solar bake sales, solar homes tours, and by sponsoring and providing energy to local events through the use of the Driving Appropriate Innovative Sustainable Education (DAISE) - a mobile energy efficiency and renewable energy educational demonstration tool. ASU REI is a student-formed and -operated committee that proposed and successfully implemented a self-imposed student tax or green fee that is used by the committee to develop renewable energy projects across the ASU campus. The ASU REI has played an important role in making ASU a leading institution of sustainable education and implementing such demonstration projects like the Biodiesel Research Project Facility (BRPF) that provides biofuel for the municipal transit system AppalCart and bringing wind back to Boone with the installation of the community scaled 100 kW Broyhill Wind Turbine. Students continue to drive ASU's sustainable presence through the AT's continuous placement in the EPA's P3 competition and the Sustainable Development

program's Sustainable Development Farm. Students of ASU are also known for becoming effectively organized when faced with issues, such as the case with Energy Coalition rallying in Washington, D.C.. In efforts to continue pushing ASU's commitment to a sustainable future, the university administration has created its Office of Sustainability. The ASU Energy Center plays a critical role in the dissemination of specialized knowledge across the region, state, and nation through programs such as the Small Wind Research and Demonstration Project (SWRDP) and Renewable Energy Workshops.

Boone's situation of a central node in specialized knowledge generation and dissemination also grants it a unique position in establishing partnerships with industry both locally and nationally. Local entrepreneurs are affiliated with ASU and relate to the CEE predominantly by student alumni that utilize their specialized knowledge by servicing the region, adding to its valuable pool of talent. These entrepreneurial partnerships and applications of specialized knowledge into the market are very much part of the area acting as a laboratory in experimenting with the dissemination of knowledge. Building Performance Engineering (BPE) is a local company that provides resources for builders, homeowners, and businesses interested in becoming more sustainable and energy efficient (Suddreth 2010). BPE is an ideal firm to represent the successful dissemination of the specialized knowledge foundational in the CEE, as it employs ASU alumni from the AT and SD programs and strengthens the social network of the region. The area is also home to non-profits that promote the CEE as a solution to regional issues of sustainability through grassroots efforts and political advocacy. Appalachian Voices is the most notable; it works towards eliminating the coal mining practice of MTR, which destroys the homes, livelihoods and ecosystems of Appalachia. As mentioned earlier, the local government and utilities have partnered with

ASU students, faculty, staff, and organizations to implement progressive programs such as the local transit system fueled by biodiesel, New River Light and Power (NRLP) part-ownership of the Broyhill Turbine making it one of North Carolina's only utilities generating clean energy, and the Boone Bike Initiative (BBI) to promote and provide resources for sustainable means of transportation. There are also two incubators to help establish businesses related to the CEE. The Appalachian Enterprise Center (AEC) provides services for earlier stage businesses and houses an array of important networks including the ASU Energy Center. The Green House serves as a cluster of CEE-associated businesses at close and intimate proximity to develop businesses that include the Appalachian Institute of Renewable Energy (AIRE), Frontline conservation real estate, and IONCON to name a few. The local community's support of these ventures of ASU and local entrepreneurs are evident through their understanding of the CEE development to be a moral responsibility, regardless of cost.

WEAKNESSES

The Boone area has relatively minimal weaknesses concerning its position as a central node of specialized knowledge production or learning region. Perspectives of renewable energies are persuaded by competing fossil fuel industries and perpetuated by both the lack of understanding and fear of change in infrastructure, thereby creating legitimate concerns for the effective implementation of alternative energy sources. In the 1970's when the Carolina Water Stoves were being installed in the High Country, out of the 129 systems that installed, there were twenty-two reported cases of 'tin men' scamming customers, essentially installing sub-par systems that did not function efficiently as they were supposed to and in some cases simply mounting the technology without integrating the systems

(Suddreth 2010). This was a practice of some contractors through the promotion of receipt-based rather than performance-based incentives. The residue of this weakness in policy is partially carried onward today; corrective actions of policy that function in this fashion can be achieved by incentives based on performance standards and documentation of efficiency and energy savings. Unfortunately, the actions of a few dishonest contractors left a bitter taste in the mouths of local home owners whose word of dissatisfaction was amplified and spread throughout the region, leaving mixed feelings and an uncertainty about renewable energies.

The experimental MOD-1 wind research project occasionally produced a low-frequency oscillation that interfered with TV reception for households in close proximity. Despite widespread appreciation and marvel at the innovative MOD-1, the documented case of one single dispute tarnished the good name of wind energy in the High Country and spread concern about future implementation of such technology in the region. It is also important to note that the MOD-1 was an experimental research project and the first generation of commercial-scale wind turbines, an essential step in the right direction in fine-tuning the technology that can be witnessed in the new Broyhill Turbine implemented by the ASU REI.

The remote nature of the area is a double-edged sword that acts as both a strength and weakness, becoming a barrier to more developed areas and reinforces the connection to the land. The remote nature of the area also helps firmly establish the cultural heritage of the region and encourages the area to be ideal for vacationing, in effect resulting in an enormous market for second homes and a crippling dependency on tourism. This Catch-22 attracts absentee home owners to the area for the aesthetic values where in turn they seasonally pump money into the local economies. This is considered a weakness to the CEE in that the

interests of these absentee home owners are not necessarily beneficial to the local communities' potential for sustainable or self-reliant economic development outside of tourism. The absentee home owners invest in the area to preserve the aesthetic value of the region and tend to become proponents of the 'Not In My Back Yard' (NIMBY) effect, regardless of whether or not they support the development of the CEE.

In addition to the perspectives of renewable energies, there are also barriers to entry related to policy and accessibility that affect the development of the CEE. Within local and federal levels of specialized knowledge there is a need for the inclusion of interdisciplinary fields to contribute to the CEE and close the interconnected gaps. This can be achieved in the Boone area both by the AT and SD programs' recognition of the importance to include other disciplines and on the other side, building and encouraging applied research in the form of integrated management towards the development of the CEE. As mentioned earlier, the proper policy needs to be implemented that promotes responsible growth and development rather than blindly throwing money at the issue (i.e. implementation of performance-based incentives rather than receipt-based incentives). On the federal level, fast track regulation for the growth of the market, proper incentivizing of support programs that invest in a responsible future, and consideration of sacrificing relatively small funds for the sake of future generations can be implemented as proactive solutions to weaknesses.

OPPORTUNITIES

There are many opportunities for the CEE in the Boone area. The economic development opportunities can play a crucial role in affecting the region's abilities to rise above the dependencies on seasonal economics of tourism and address the ever-mounting effects of GCC that are affecting such foundational industries as the seasonal Christmas tree

choose and cut as well as the various diminishing ski resorts. Continued implementation and growth of demonstration projects can not only reinforce trust in the innovative efforts of the area but also be utilized as an additional source of educational tourism for those curious about the technology as it can continue to be incorporated into the rich cultural heritage of the region. This also opens the flood gates for additional and far reaching partnerships between industry, government, and learning institutions. With more market force driving a growth of the CEE, more progressive policy can be pushed to further promote economic development opportunities designed to sustain growth and the self reliance of communities. As reason dictates, these efforts will act as a catalyst to influence Federal and regional policy, thereby increasing incentives and the momentum of advancements in innovative technology development, the continued successful adoption of these practices in local businesses, and application of innovative solutions to jump-start the CEE and solve regional and nationally pressing issues.

ASU's continuous growth and diverse population contribute to the opportunity for the advancement of the region as a nationally recognized learning region for the CEE. As ASU continues to develop its sports programs for example, a whole new market is flocking to the area that has traditionally not been exposed to the concepts embraced by the Boone area. The exposure to a new market can potentially further demonstrate the importance of the research application conducted at ASU and increase the potential funding. This would allow further opportunities to form new partnerships and the production of valuable projects from progressive education to the tangible needs of a population. With ASU's growth, the Town of Boone has historically struggled in the shadow of the University. The sustainable principles that drive the CEE, however, include an embedded nature of uniting community and building

social capital, allowing the University to mend and reinforce the bonds between it and the Town of Boone (i.e. working with each other rather than against). There is also the potential to use aged infrastructure as a transitional means of implementing energy efficiency technologies, preparing for a renewable energy campaign and demonstrating the possibilities of the developmental stages in the CEE. The expansion of transportation infrastructure leading into the Boone area can serve to broaden the influx of an even more diverse population, exposing people to the rich cultural heritage of the region and opening the area to increasing economic opportunities.

THREATS

Much like weaknesses, there are few to no threats associated with the development of the CEE and the Boone area's role as a central node of producing innovative specialized knowledge. The debatable issue concerning the aesthetic value of implementing renewable energy technologies such as wind continues to threaten the regional development of an economy based on place-based resources. Though the CEE itself is not entirely threatened by the effect of a single technology, the concept of NIMBY is a serious threat. Embracing an understanding of our effects on the environment, equity, and the economy through consumption of energy can ensure a sustainable world for future generations. The influence and control of power can possibly pose a threat to the masses for the profit of a few, whether it be from absentee home owners of the local area or international fossil fuel companies affecting policy that favors environmentally harmful energy sources, this potential threat is evident of a lack or un-attachment to the environment and its people.

There are economic impacts that could potentially pose a threat to the development of the CEE in the Boone area. If the economic crisis continues to persist in the manner that it

affects the market through individuals' tendencies to conserve spending, the hesitation to invest will slow the process of transitioning to alternative energy sources and a way of life that can sustain future generations. This can also have detrimental effects on policy and government spending designed to support research and development of innovative solutions to timely issues, resulting in continued cuts of educational budgets, which could cripple the progression of our nation and condemn the human race to failure. As mentioned before, the possibility of developing the CEE that is based on the values of cultural heritage in WNC could result in the over-commercialization or selling out the uniqueness of the region.

SOCIAL NETWORKS

The social capital that operates in the Boone area is a diverse network that spans ASU, local communities, and the WNC region. Key actors in the social network include employees and students of ASU, and local entrepreneurs. They scale vertically from federal to local government structures to within the community and amongst various organizations. Samples of five key actors within the Boone community have been chosen to explore and demonstrate the interactions and connections of such social networks.

Dr. John Pine is a faculty member in ASU's Department of Geography and Planning and serves as the Director of the Research Institute on Environment, Energy, and Economics (RIEEE). Dr. Pine directs the faculty and operations of three research centers that analyze environmental, energy, and economic policy, working on local and state levels to develop the framework of research and a supportive structure. Dr. Pine obtained his formal education at the University of Georgia and spent close to thirty years conducting environmental science research on human and environmental disasters and hazards at Louisiana State University.

Dr. Pine is an expert in collaborating partnerships, engaging all parties in the entire gamut of science (human and physical) to address environmental issues driven by policy. He is connected to all scales of community as a political stakeholder engaging ASU on the development of environmental issues to meet the economic development needs of the nation. Dr. Pine's local commitments in addition to his involvement with the RIEEE include the Grandfather Learning Lodge where partnerships with the Grandfather Mountain Stewardship Foundation, the National Audubon Society, the Nature Conservancy, the North Carolina Museum of Natural Sciences, the Blue Ridge Parkway, and ASU support environmental research, education programs, and outreach. His involvements with Federal agencies include National Oceanic and Atmospheric Administration (NOAA), EPA, Federal Emergency Management Agency (FEMA), and the Oak Ridge National Laboratory among others. Dr. Pine is also working to continue developing collaborative partnerships with ASU and community colleges that will result in the development of energy related curriculums. Dr. Pine continues to utilize ASU's well-suited position of engagement with environmental issues as a platform in shaping emerging public policy as it is related to the CEE (Pine 2010).

Scott Suddreth is the Technical Director at BPE, a Boone firm that provides resources for builders, homeowners, and businesses interested in becoming more sustainable and energy efficient. Scott obtained both his bachelor's and master's degrees from ASU's AT program with a minor in SD. Hailing from the Lenoir/Hickory area, Scott is deeply connected to the land and plays an important role as a key actor in the development of the region's CEE. He was a founding member of both the student organization ASUSES and the community-based ARISE. Scott's foundational role in ASUSES included establishing the club's annual Christmas tree lighting powered by solar energy, engaging the club in at least

twenty-four national and regional conferences and workshops, organizing fund raising events, and uniting the community. At one point Scott stepped up the sustainable technology community's education and outreach efforts by challenging the leaders of the ASES to meet the efforts of ASUSES. Scott established his role in the region's progressive efforts by attending several highly regarded expos and events that focus on sustainable energy outreach, hosting a radio segment as the go-to guy on technical expertise, advising on several renewable energy projects including the new Watauga High School, and helping local entrepreneurs develop their renewable energy businesses. Through his efforts, Scott also helped to establish several of the areas demonstration projects such as the micro-hydro systems of Molly's Branch and Turtle Island. Scott grew up in the Lenoir/Hickory area, witnessed the decline of the area's economic backbone of furniture manufacturing, filled his head with the ideas and concepts of *Mother Earth News* and serves as an iconic example of the potential that the area can offer in developing the CEE (Suddreth 2010).

John Lehman is a Research Analyst at the ASU Energy Center where he analyzes economic and energy policy. Dr. Lehman received his bachelor's degree from Bloomsburg University, his masters from Virginia Tech, and his PhD from Ohio State, and has a history of working with policy research. The very nature of Dr. Lehman's position at the ASU Energy Center involves him in the University's community dealing with anything energy policy related, naturally connecting him to all the major players of energy, environment, and economy associated with the University. Dr. Lehman assists regional businesses and local governments in identifying resources (including those of ASU), conducting energy policy research, identifying information on credits and grants, and preparing research proposals. Dr. Lehman works within a diverse network of state agencies such as the North Carolina Energy

Office and North Carolina Solar Center among others, educational institutions such as Virginia Polytechnic Institute and State University, Vanderbilt University, and Kansas State University, as well as major utility companies such as Duke. Dr. Lehman's policy work includes emerging energy issues such as the NC SB 10-68 related to wind energy in the mountains and the NCREPS. Dr. Lehman also works to determine how utilities can work in renewable energy such as large and small scale poultry and swine waste as sources of combustible fuels (Lehman 2010).

Patrick Beville is a local entrepreneur who started his own engineering limited liability corporation, IONCON, that is located in the GreenHouse and provides structural consultation services in engineering, renewable energy, and conservation. Mr. Beville received his bachelor's from NC State, his masters from ASU, and is continuing his education with the NC State University's Green Building diploma. Mr. Beville hails from Asheville and has secured impressive network ties in the Boone Clean Energy community. Before starting his own company, Mr. Beville worked for ASU's Department of Design and Construction where he played a crucial role as an advisor (i.e., bridging gaps and assisting as an administration liaison) in providing technical expertise in the completion of all ASU REI major projects. Mr. Beville is connected to the community through various organizations such as Boone Green Drinks, the Mountain Keepers, the Chamber of Commerce, and the Town of Boone (Beville 2010).

Rio Tazewell works for AIRE through a fellowship from ASU. Mr. Tazewell received two bachelor's degrees from ASU in SD and Political Science with a minor in AT. Before working for AIRE, Mr. Tazewell interned with the Environmental Defense Fund (EDF) where he performed lobbying and other political functions. Mr. Tazewell developed a

healthy network when attending ASU through his political organization efforts and involvement in several environmentally-focused student organizations. His political grassroots efforts include organization through the Southern Energy Network and the Energy Action Coalition where he mobilized college youth for the Power Shift of 2007 and 2009 on Capitol Hill. His involvement with student organizations at ASU included serving as a committee member on the ASU REI and an officer with both ASUSES and the Sustainable Development Association (SDA). Mr. Tazewell is applying his passion for organizing communities towards the development of the CEE by growing the network and increasing information access to local populations (Tazewell 2010).

CONCLUSION

By establishing a geographic profile, performing a SWOT analysis, and conducting interviews with community stakeholders to create a landscape of local social networks, it becomes evident that the Boone area is a learning region where specialized knowledge of sustainable lifestyles is generated. In Boone the particularities of place provide an ideal situation for the research and development of sustainable principals and practices while essentially proving to be an on-going community-scale experiment of energy's impact on political, economic, and environmental issues. Analyzing the strengths, weaknesses, opportunities, and threats indicates that the situation present in Boone offers a pristine environment of a remote nature that promotes self sustaining economies nurtured by the local mountain culture and heritage ideal for initiating dynamic and innovative partnerships between learning institutions and industry towards forging new economic ground for capitalist societies in a changing world. Interviewing a sample of key community

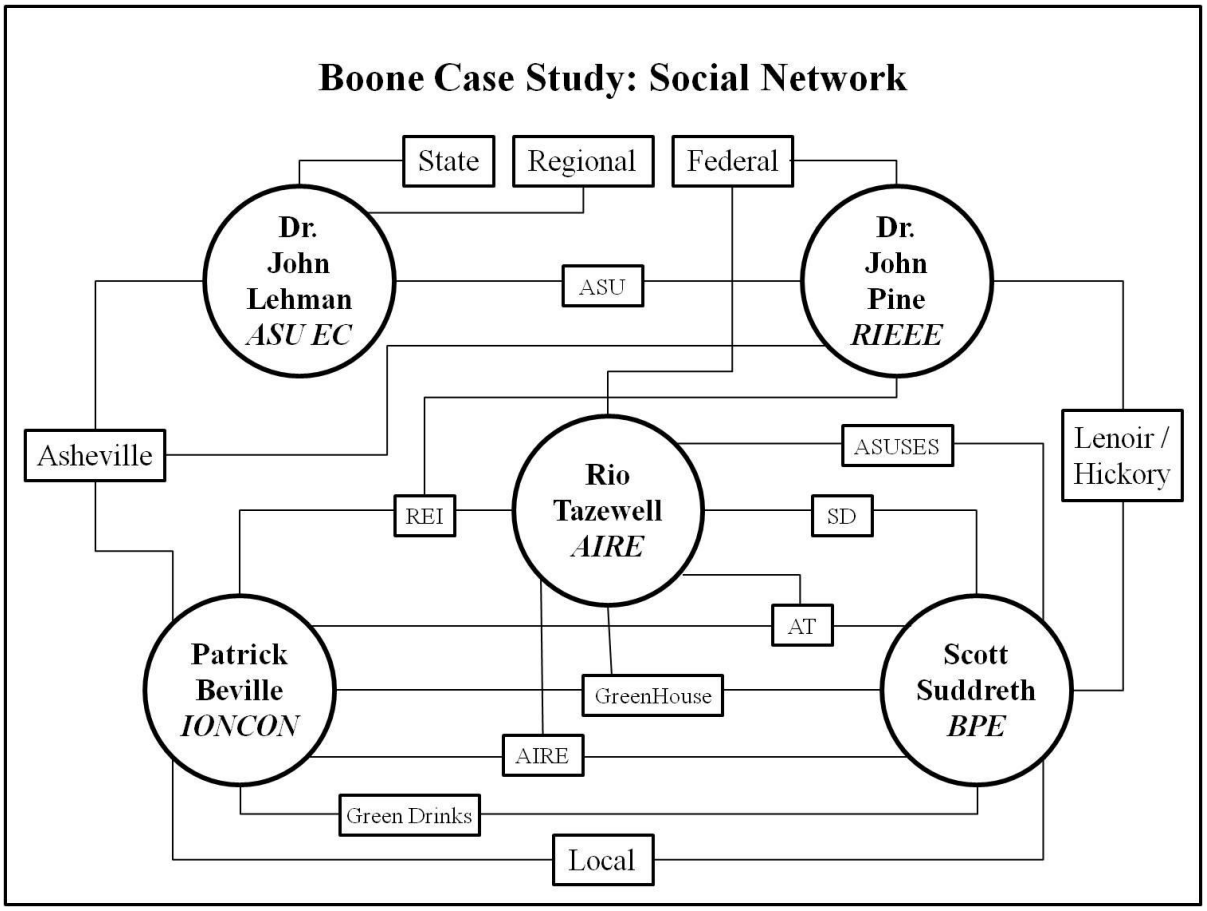


Figure 5. Boone Case Study: Social Network.

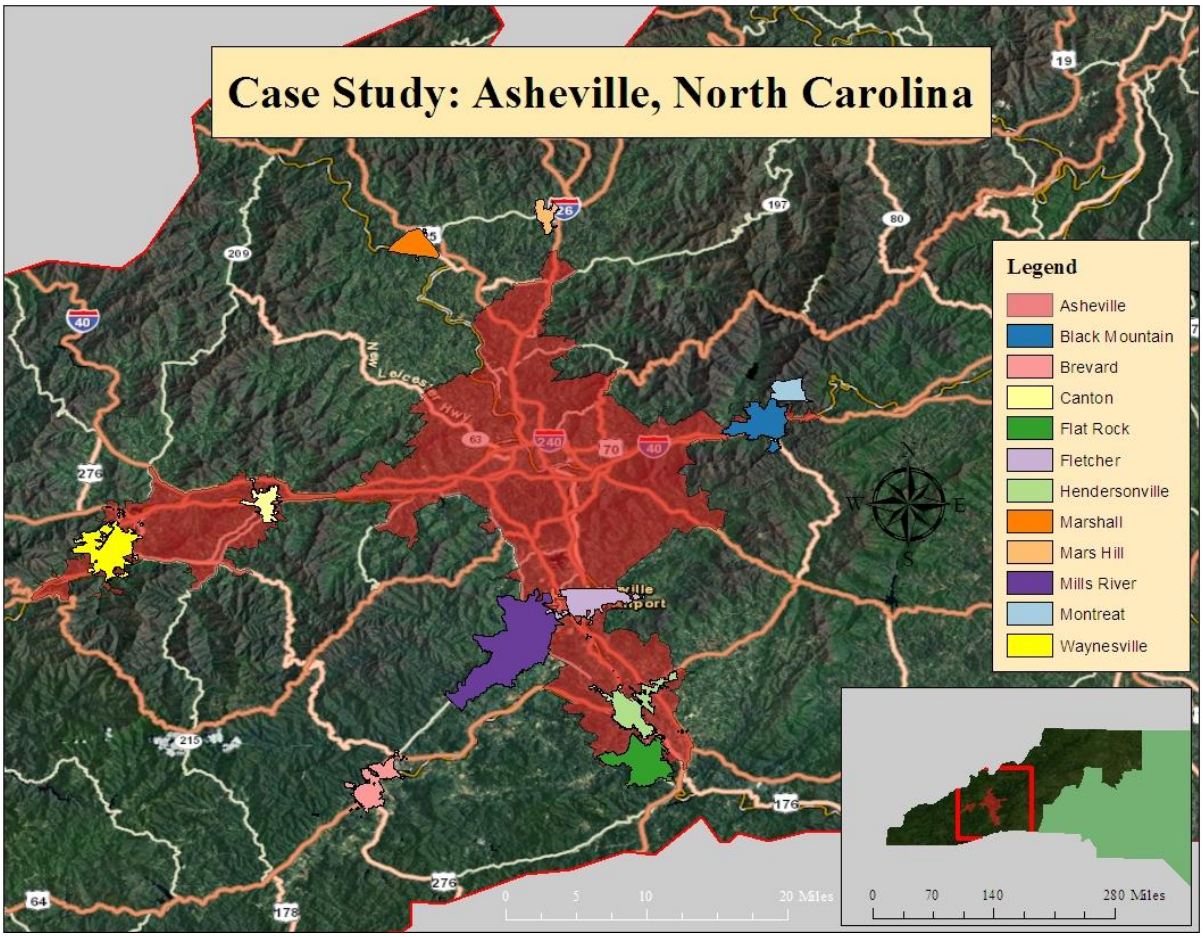
stakeholders reveals an interconnected social network (Figure 5) across a variety of scales with strong ties to each study area linked through common goals of sustainable principles and practices.

CHAPTER 5 - CASE STUDY: ASHEVILLE

Figure 6. Asheville, North Carolina. *Source*: Apple Wood Manor Inn 2012.

GEOGRAPHIC PROFILE

"Located approximately in the middle of the WNC region the City of Asheville (Figure 6) is the largest city in the region and county seat of Buncombe County that serves as a regional hub for business, arts, health and human services" (City of Asheville 2011). The area is within former Cherokee nation boundaries nestled in the Swannanoa Valley, considered a jewel of the Southeast with its vibrant culture of creative arts that attract both locals in the region and tourists alike. Asheville is located at an elevation of 2,216 feet (675 meters) above sea level. The City of Asheville (Map 6) is located at the intersection of Interstates 40 (running East/West) and 26 (running North/South), Highways 19 (running North/South), 23 (running North/South), 25 (running North/South), 70 (running East/West),



Map 6. Case Study: Asheville, North Carolina.

74 (running East/West), and in close proximity to the Blue Ridge Parkway. For the purposes of this research the Asheville area is defined as the collective local communities of the Metro Statistical Area (MSA) which most notably includes Asheville, Black Mountain, Brevard, Canton, Flat Rock, Fletcher, Hendersonville, Marshall, Mars Hill, Mills River, Montreat, and Waynesville. Resting in the Appalachian Mountain Range, the Asheville area is home to a diverse and vibrant metropolitan mountain community that possesses the unique combination of a large urban population that is environmentally oriented and connected with the means to influence a major market infrastructure.

Economic indicators of the Asheville area are well established in a variety of professional, public and health services. “Asheville has been named one of the nations ‘Best

Places for Businesses and Careers' by *Forbes Magazine* as an eclectic sophisticated region within a culturally and economically diverse community where lifestyle meets business opportunity and technology meets creativity" (Asheville Area Chamber of Commerce - Regional Information 2011). The Asheville area continues to grow its market share of knowledge-based companies that include professional and technical specialists in manufacturing, information technology, global information systems, and media arts. These and the growing implementation of sustainable practices of policy and the development of clean energy companies based out of the area prove to be a crucial component of applying the specialized knowledge production from the area towards the CEE for both the region and the nation.

In addition, the Asheville area continues to make great strides in making innovative progress in the technology sectors related to clean energy and an established center for fiber network development, aerospace growth, and is a weather and climate center. "Asheville's metropolitan area alone has a $13.2 billion economy with a diverse yet balanced mix of knowledge-based enterprises, advanced manufacturing, professional services, and growth industry companies" (Economic Development Coalition for Asheville-Buncombe County 2010). This sheer size of economic worth testifies to the Asheville area as the dissemination factor of sustainable practices that encompass the CEE. "The City of Asheville is the largest urban hub in the WNC region with an estimated 2009 population of approximately 75,000; the larger encompassing MSA (consisting of Buncombe, Haywood, Henderson, and Madison Counties) has an estimated 2009 population of approximately 417,000" (Asheville Area Chamber of Commerce - Demographics and Regional Data: Local Population 2010).

"The Asheville MSA's 2009 demographics are predominantly white (88.8% in Buncombe, 96% in Haywood, 89.1% in Henderson, and 96.7% in Madison Counties), approximately equal distribution between male and females, a median age of 42.95, and education attainment levels above national averages in Buncombe and below in Haywood, Henderson, and Madison Counties" (U.S. Census Bureau - North Carolina 2011). The area's population is predominantly comprised of locals who settle in the region with the exception of the City of Asheville that attracts a unique mixture of regional locals and an influx of like-minded young professionals and retirees alike from the region who are drawn by the promise of the area's natural beauty and the alternative lifestyles. The culture is a mixture of mountain heritage and creative arts, attracting entrepreneurs with promise of a developed economy catering to innovation in a mountain setting. The area is nestled in a geographic bowl that allows these populations to live by the mountain values while having access to the conveniences of a metropolitan area and infrastructure. The Asheville area's communities are supplied with a variety of economic development organizations and community-based programs that unite the efforts towards development of the CEE.

SWOT ANALYSIS

STRENGTHS

The Asheville area is crucial to the development of the WNC CEE in that it is a regional hub of economic activity and serves as an important vehicle in disseminating specialized knowledge into the market. The area contains a large portion of the WNC region population with a national recognition of progressive lifestyles of environmental consciences while maintaining a healthy and vibrant economy. In addition to having several educational institutions in the area, there are a variety of valuable CEE resources available in the area

including several regional organizations and businesses that support the Sustainability movement basing them in the local communities surrounding the Asheville area. The social networks that link these efforts to local communities are exceptionally strong, reaching far into the region and beyond.

The existing economic infrastructure established in the Asheville area serves as a tremendous strength for the development of the CEE in the region and provides a foundational source in generating the financial capital to fuel the sustainable movement that other areas lack. This existing and growing market is difficult to allocate to just one industry, rather than exclusively limited to businesses that deal directly with energy efficiency and renewable energy technologies the CEE bleeds into several different industries and services. The building science industry itself encompasses a large portion of the CEE efforts through integrating methods spanning into every aspect of our lives. The Asheville area is in no short supply of either businesses venturing into the clean energy aspects of market shares or entrepreneurs that are exploring the implementation of this innovative yet intuitive lifestyle movement, effectively creating a place where innovation meets the marketplace. Like the Boone area, the Asheville area is one that leads the implementation of local and regional policy to aid the development of the CEE – expediting building permits, wind ordinances, and programs to initiate and secure the transition to a CEE (AdvantageWest – Western North Carolina Economic Development Group 2006; Land-of-Sky Regional Council 2010).

The network of organizations and businesses in the Asheville area has a history in connecting people of the region to the environment. In the 1970's *Mother Earth News*, a progressive magazine that brought renewable energy and sustainable lifestyles to the public, moved its operation to Hendersonville and with it a following of like-minded individuals

who drove the sustainable movement. These entrepreneurs spread throughout the region and blended harmoniously with the mountain culture to build the area into the progressive place that it is today. Out of these efforts developed a new growth of organizations and businesses that continue to promote the CEE infrastructure. Media sources such as the *Mountain Xpress* and the regional listener-powered radio station Western North Carolina Windows (WNCW) are in part products of these continuing efforts of spreading the mountain culture and the progressive sustainable lifestyles through community-based programs aimed at strengthening ties and uniting connections. Among the growing businesses of the CEE in the area there are concentrations of economic development organizations that function in part to develop and capitalize on the unique attributes that the region possesses. Civic and economic organizations come in various forms that most notably include the Hub, Asheville Green Drinks, WNCGBC, Land-of-Sky Regional Council and AdvantageWest. These organizations work in a variety of mediums to develop the CEE including social networking, local and regional policy and legislation, implementing incentives, and setting industry standards.

In addition, there are various educational institutions in the Asheville area that help to provide a steady flow of able and willing workforce. Of these WWC is a nationally recognized institution that specializes in sustainable practices and lifestyles, contributing to the unique nature and culture that is present in the area. These educational institutions play a crucial role in partnerships between industry, providing a necessary connection of bringing new and innovative methods and practices to CEE businesses and the communities that are in need of making a transition to sustainable lifestyles, bridging the gap between economy, equity, and environment. The Asheville area is unique in that it attracts an ample amount of social capital in the forms of highly educated individuals with creative and specialized

knowledge to the area, willing and able to contribute to the development of the CEE. The local communities and businesses of the area are directly connected to the CEE as a whole by supporting its development through accepting the moral responsibilities of implementing sustainable practices.

The natural and economic infrastructures that exist in the Asheville area also act as strengths of the area in its potential to produce local markets and export CEE commerce. The local climate is mild and provides suitable solar resources to power either PV or ST technologies. The surrounding mountains have enough tributaries and streams to support relatively productive micro-hydro power. Due to the area's location in a mountainous region, there are also wind resources that can be utilized for power production. The major interstates, highways, and rail systems that run through and transect the area in conjunction with the regional airport serve as transportation routes for moving products and services to local and far reaching areas.

WEAKNESSES

There are few to no weaknesses for the Asheville area as a cluster of organizations and businesses disseminating specialized knowledge into the market in regards to the development of the CEE. Though there are those who oppose the CEE economy, they are far outweighed by the sheer volume and mass of those fighting for the cause in the area coupled with the embedded innovative of the mountain culture. There is a constant turnover of young educated adults in the area that results from a larger supply than the demand for such a large work force. But this plays more as a strength rather than a weakness, serving as a reserve of a specialized labor pool prepared for the continued development of the CEE. The current economic recession can be viewed as a weakness where aspects of the development of the

CEE are affected. However, the current economic recession also serves as a strength in combination with the inevitable depletion of carbon-based energy and the pressing need to begin a transition to alternative energy solutions. The continuous stagnation of progressive national legislation and policy poses as a weakness. Much like the other viewed weaknesses, this too doubles as a strength by providing motivation for establishment of regional and local policy developed towards the growth of the CEE.

OPPORTUNITIES

The opportunities of the Asheville area continuing its growth and development of the CEE are in line with improving the regions previously mentioned current strengths. The local Asheville area economy could potentially strengthen the regions supply chains and stimulate service sectors. The continued development of the CEE will thereby increase the additions of employment opportunities and allow a portion of the specialized labor pool to capitalize on their skills and abilities by implementing acquired knowledge into the market and open up service sector positions to those in need of them, equalizing job displacement. The Asheville area can potentially serve as a beacon and lead by example for the Southeast, where transition to a CEE will prove to be one of the nation's challenges in the transition to alternative energy and sustainable lifestyles. As mentioned previously, the current economic recession can serve as an opportunity for the region to act as a model for the Southeast region, promoting the unity of communities and the resurgence of economic development in challenging times. This new paradigm can serve as a mechanism to initiate progression of legislation and policy by demonstrating its success and efforts that can be set in place to potentially model such success. The collaboration of multiple municipalities and regional efforts towards common goals such as the green transportation initiatives in response to

energy crisis's creates limitless opportunities of partnership within the region. Establishment of a REC market grants the area opportunities of an un-taped market and the promise of unrelated industries the capabilities of participating in the CEE. Social network forces such as greengov allow a connection of individuals and organizations to unite in a fashion yet to be experienced by the region.

THREATS

Much like the weaknesses, the Asheville area has few to no threats as a cluster that disseminates specialized knowledge into the market in regards to the development of the CEE. The most impending threats to the area and the potential of the CEE are related to national political restraints of legislation stagnation related to controversial views on alternative energy sources role in the US society. This can influence the incentives currently in place that help to drive the private sector of the CEE, assistance from regional economic development organizations, and government funding. Much of this hangs in the balance of the current economic recession and the actions that will be taken by federal government. There is the potential threat of over capitalizing on the regional mountain and creative art culture, but this seems highly unlikely considering the momentum that ensues from these various aspects in the Asheville area.

SOCIAL NETWORK

The social capital that operates in the Asheville area is a diverse network that spans within the WNC region and further, to both state and national levels. Key actors in the social network include those employed by local municipalities, businesses and entrepreneurs, regional economic development organizations, media services, and those in various transitions. They scale vertically from federal to local government structures to that of

horizontally within the Asheville area community and amidst various organizations. Samples of five key actors within the Asheville community have been chosen to explore and demonstrate the interactions and connections of such social networks.

Ned Ryan Doyle plays a crucial role in the development of the CEE in WNC through his broad networks as a 'independent contractor for the cosmos', a 30-year self employed advocate and entrepreneur for sustainability, a writer, an educator, founder and director of both the annual Southern Energy and Environment (SEE) Expo and the Rational Earth Actions Learning Institute, Thank You (REALITY), and the producer and host of WNCW's Sunday morning radio program Our Southern Community (Doyle 2010). Mr. Doyle also played a crucial role with *Mother Earth News* back in the 1970's and as the coordinator for its original 622 acre Eco Village Research Center located in Transylvania County, open to the public from 1979 to 1985 (Rational Earth Actions Learning Institute, Thank You 2007). REALITY has taken on where *Mother Earth News* left off, now seasonally operating the facility and founded on the same down-to-earth principles of renewable energy, green building, and sustainable agriculture. Although Mr. Doyle has not acquired any formal education, he has obtained his self-taught education and technical expertise through grassroots efforts and hands-on approach that continues to forge paths and teaching those who are now gaining formal education in sustainable lifestyles (Doyle 2010).

Mr. Doyle's connection to the regional community is inherent in all of his activities and venture, through advocacy to educational roles he is constantly interacting on scales from local businesses and organizations to that of Federal agencies and committees. When Mr. Doyle is not coordinating regional CEE events, he is attending them throughout the nation. Among others, Mr. Doyle has been employed by Southern Energy, NC Green Power, Annual

Southern Energy and served on several boards including the before mentioned, North Carolina Sustainable Energy Association (NCSEA), and the Steering Committee of the Western North Carolina Alliance. Mr. Doyle's radio program, Our Southern Community, connects the public through exploring the people and the issues of the environment, energy, and economy of the Southern region. Mr. Doyle continues to serve as an archetype of the ingenuity and innovation of the people in the region and bridges the gap between generations and providing sustainable solutions to pressing issues of our times, a prime example of the powerful individuals that collectively make up the CEE in the WNC region.

Margaret Ullman is the Energy Coordinator for the City of Asheville's Office of Sustainability, charged with reducing the City's carbon emissions 2% per until 80% is reached and supporting local government's institutionalizing triple bottom line practices in its infrastructure and services (Ullman 2010). Ms. Ullman obtained her bachelors of Science in Environmental Policy and Economics from the University of North Carolina Asheville (UNCA). Before becoming the Asheville Energy Coordinator she worked in Atlanta as a Transportation Planner with Metropolitan Atlanta Rapid Transit Authority (MARTA) and for Southface Energy Institute building holistic communities. Mrs. Ullman is inherently connected to the community both through her position's responsibilities and the network that she finds herself continually building in the community around her. Ms. Ullman is essentially a public servant who is directly connected to the will of the Asheville citizens by following a hierarchy in the following descending order: the 75,000 Asheville citizens relay their wants and needs to the seven City Council members, who then relay the directives to the City Manager, who in turn relies on Mrs. Ullman to accomplish the set goals (Ullman 2010). As a representative of the Asheville government's efforts towards sustainable efforts, Ms. Ullman

provides a face and ear for local and regional events and hence strengthens the WNC CEE network by interacting with organizations such as WWC (formal relationship to battle climate change via political relations – Federal Energy Bill), Asheville Hub, Sustainable Asheville, Sustainable Energy Council of Western North Carolina (SECWNC), Advantage West, the NCSEO, and Asheville Green Drinks to name a few.

Ty Hallock is the CEO of Top Floor Studio, a web design and mobile management firm that serves small nonprofits and green businesses, and the coordinator and co-founder of Asheville Green Drinks, a social network initiative for Sustainability (Hallock 2010). Asheville Green Drinks plays a crucial role in the development of the WNC CEE by providing a social networking opportunity every Friday night at local venues for local businesses, entrepreneurs, and individuals of the community to interact in an informal setting and learn more about each other and the latest innovative initiatives of leaders in the WNC CEE. Mr. Hallock gained ten years' experience in Orlando, Florida before moving to the Asheville area because of the mountain culture that is more in line with his lifestyle choices and nurtures a sense of place for a sustainable culture. The nature of Mr. Hallock's profession and passion places him in a natural position to network with organizations such as *Mountain Biz Works*, *Mountain Express*, the Asheville City Council, and Advantage West among others in various settings and events in the region and across the nation. Though Mr. Hallocks profession is not considered a traditional industry of the CEE, his connection to the establishment and strengthening of its social infrastructure proves the integrative and ambiguous interconnected nature of the CEE in uniting communities for bridging gaps and improving the quality of life by overcoming obstacles through braking barriers with innovative solutions.

Maggie Leslie is the Program Director for the WNCGBC, a nonprofit educational organization charged with raising awareness of the health and environmental impacts of design and construction (Leslie 2010). The WNCGBC plays a crucial role in the development of the WNC CEE as a contributing source of developing the backbone of the foundational industries driving the CEE, addressing the 'low hanging fruits' and tackling the basic issues surrounding the development of the CEE. Mrs. Leslie gained her education and specialized knowledge by drawing from her experiences with WWC, Southface Energy Institute, and her time spent within the communities of the Asheville area. The WNCGBC is connected to the regional community through its relationships with educational institutions, local media sources, regional economic development organizations, and local governments.

The WNCGBC is active with community colleges to improve and establish curriculums and continuing education programs and through general outreach efforts. Media sources such as *Mountain Xpress* and *Smokey Mountain Press* provide instrumental partnerships for WNCGBC in assisting with outreach and awareness efforts; WNCGBC partners with Mountain Xpress to publish the annual Western North Carolina Green Building Directory (WNCGBD), which includes a wide spectrum of CEE businesses and services. Local regional economic development organizations Advantage West and Land-of-Sky Regional Council work in close relation with the WNCGBC to establish standards and regulations for the many CEE programs initiated across the region and state. WNCGBC also works with local governments and Homebuilder Associations in a similar capacity.

Michael Leahey is the Director of the Asheville Hub Sustainability Program, a local initiative that acts as a networking catalyst to develop the CEE in WNC. Mr. Leahey has played a crucial role through the actions of Asheville Hub as an essential think tank in

fostering partnerships among industries and building a foundational social infrastructure and framework to focus on the regional resources of WNC and its development into a CEE cluster (Leahey 2010). Mr. Leahey's education from UNCA is centered on Economic Development by means of asset-based development with priority based on wellness and rejuvenation of communities. Mr. Leahey's specialized knowledge strongly emphasizes the principles of sustainability and have naturally connected him and the Asheville Hub to other local organizations and initiatives with common goals such as Advantage West, Land-of-Sky Regional Council, the Asheville Chamber of Commerce, NCDC, City of Asheville Office of Sustainability, WWC, and the Blue Ridge Sustainability Institute among others.

CONCLUSION

By establishing a geographic profile, performing a SWOT analysis, and conducting interviews with community stakeholders to create a landscape of local social networks, it becomes evident that the Asheville area is also a learning region where specialized knowledge of sustainable lifestyles are disseminated into local, regional, and national markets. In Asheville the particularities of place provide an ideal situation for the research and development of sustainable principles and practices while essentially proving to be the spawning ground for regionally-based economic development in the CEE. Analyzing the strengths, weaknesses, opportunities, and threats indicate that the situation present in Asheville offers a regional hub promoting a self sustaining economy nurtured by dynamic and innovative partnerships between learning institutions and regional industry towards a vibrant CEE. Interviewing a sample of key community stakeholders reveals (Figure 7) an interconnected social network across a variety of scales with strong ties to each study areas and linked through common goals of sustainable principles and practices.

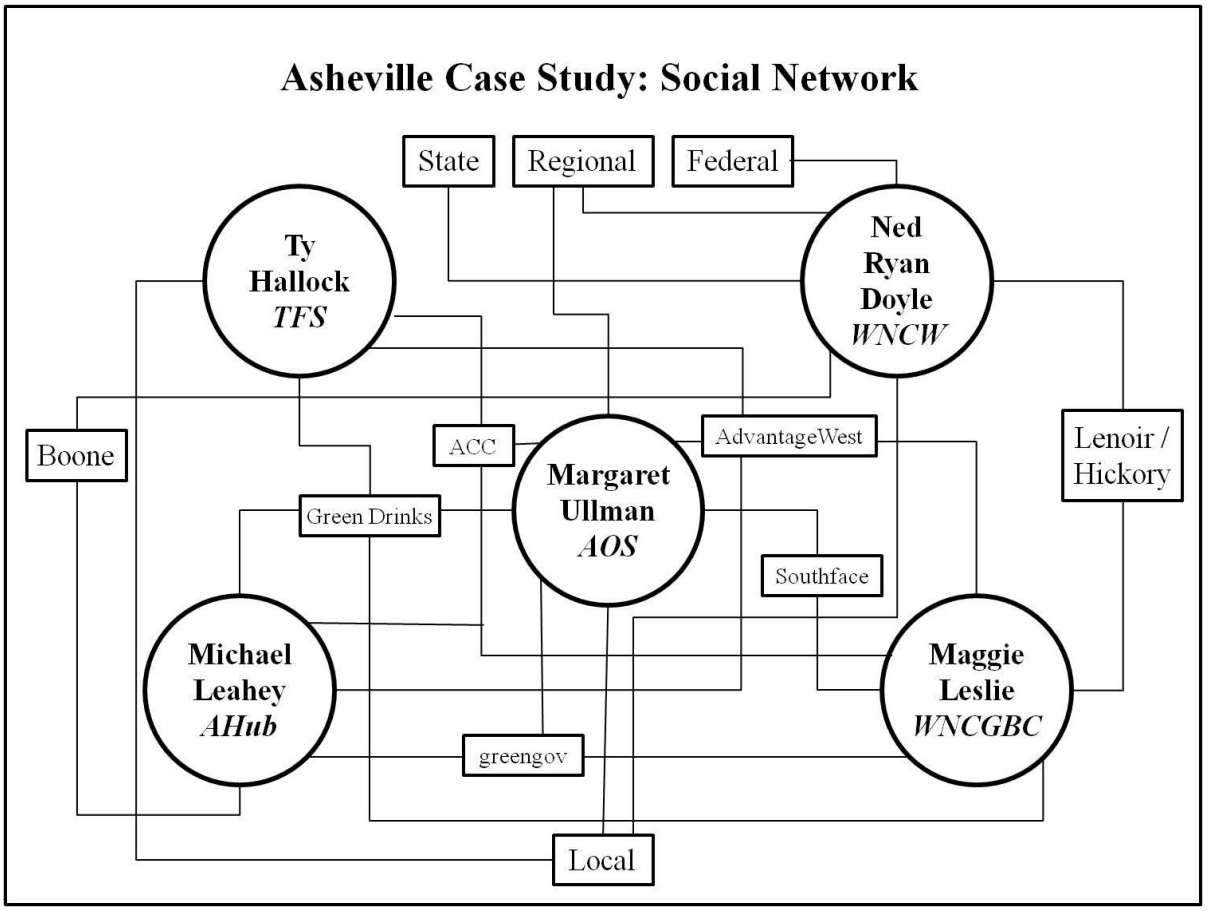


Figure 7. Asheville Case Study: Social Network.

CHAPTER 6 - CASE STUDY: LENOIR AND HICKORY

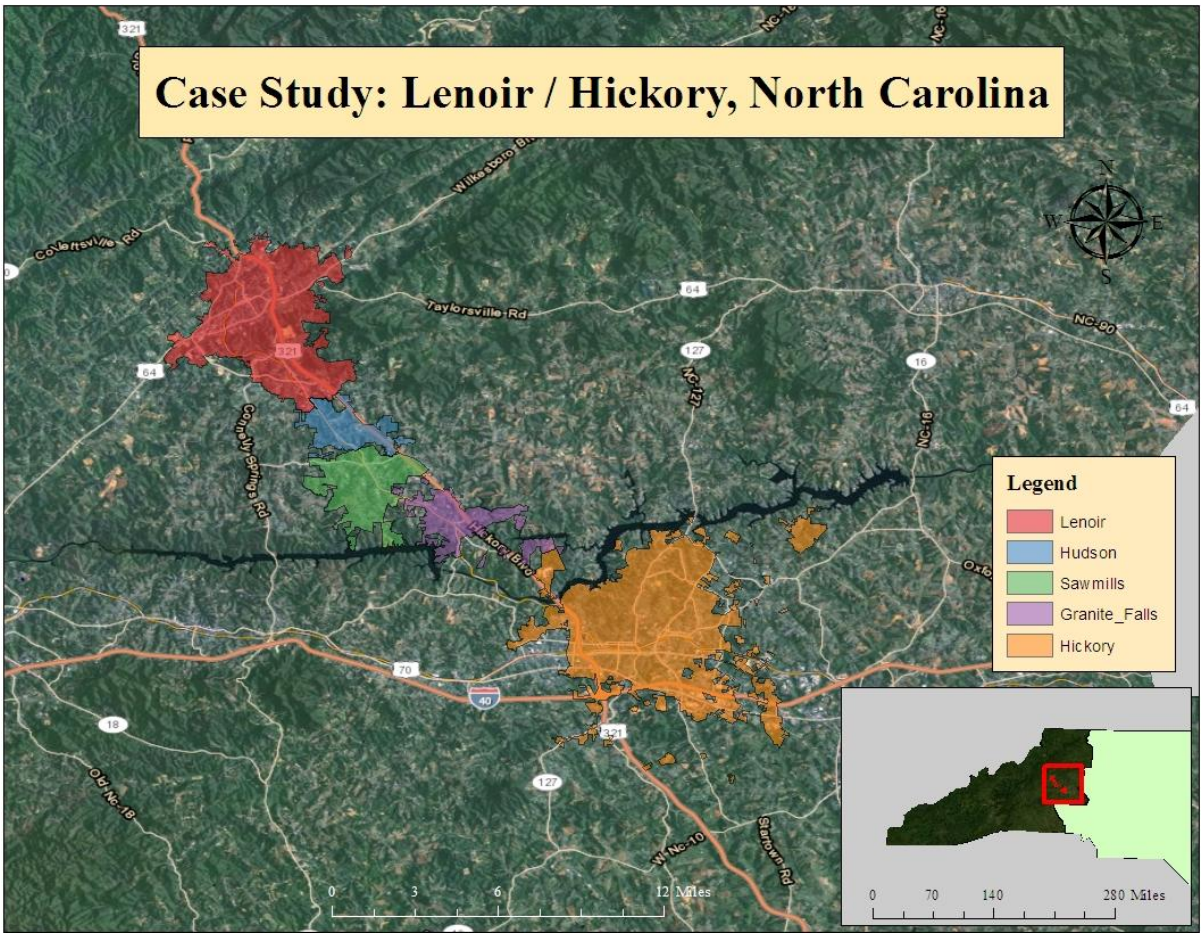
Figure 8. Lenoir, North Carolina

GEOGRAPHIC PROFILE

The Lenoir and Hickory area (Figures 8 and 9) is comprised of the neighboring communities surrounding both cities of Lenoir and Hickory, located on the Highway 321 corridor, where Lenoir rests in the Blue Ridge foothills and Hickory in the Catawba Valley. Both Lenoir and Hickory are the seats of their respective Counties, Caldwell and Catawba. Though Hickory is technically not considered a part of the WNC region by definition of regional economic development organizations, it will be for the scope of this research due to the interconnectedness with the economic and transportation infrastructure of Lenoir, and the

Figure 9. Hickory, North Carolina

crucial link to both the Boone and Asheville areas in relation to the development of the CEE. Lenoir is located at an elevation of 1,183 feet (361 meters) and Hickory at an elevation of 1161 feet (354 meters). Both Lenoir and Hickory are located (Map 7) on the Highway 321 corridor (running North/South), Lenoir at the junction of Highway 64 (running East/West) and Hickory at the junction of both Interstate 40 (running East/West) and Highway 70 (running East/West). For the purpose of this research the Lenoir/Hickory area is defined as the collective local communities of Granite Falls, Hickory, Hudson, Lenoir, and Sawmills, running the 321 corridor between Lenoir and Hickory. The Lenoir/Hickory area is in no short supply of natural, social, and transportation resources including major rail ways, interstates and highways, regional airport, and close proximity to metropolitan hubs.



Map 7. Case Study: Lenoir / Hickory, North Carolina.

Economic indicators of the Lenoir and Hickory area are well established in the manufacturing industries. Both Lenoir and Hickory have been named All-American Cities and recognized as ideal places to raise families and start businesses. The Lenoir/Hickory area has historically been a national leader in the manufacturing of furniture and textiles throughout the Highway 321 corridor. The area has seen a devastating downturn in its economic backbone in manufacturing since the early 2000's and has been searching for alternative means of supplementing its suffering economy. "The local economy has at least $5 billion worth in retail economy and continues to grow in new markets such as information technology demonstrated by proudly becoming the new homes for both Google and Apple databanks and warehouses" (Catawba Economic Development Corporation 2011). The area's

growing partnerships between learning institutions and industry can serve as a crucial factor in bridging gaps in establishing a CEE within the existing infrastructure offered by the area. In addition, the recent expansion of unemployed workers with manufacturing skill sets and a specialized labor pool can be alleviated by the movement into the CEE. The furniture industry alone lost approximately 18,000 jobs, textile mills and electric equipment approximately 6,000, and fabricated metal products and parts approximately 1,200 since 2000 (Western Piedmont Council of Governments 2011). The fact of an economic struggle for the area coupled by the drive of the communities to utilize their specialized skills in adapting to economic challenges speaks volumes to the potential of the area in capitalizing on the manufacturing aspect of the development of the CEE.

The Lenoir/Hickory area demographics are predominantly white (77% and 73% respectively), approximately equal distributions between male and females, a median age of approximately 39, and education attainment levels below national averages in Lenoir and around national averages in Hickory (U.S. Census Bureau - North Carolina 2001). The area's population is predominately comprised of locals, mostly farmers and textile workers generations thick who have settled in the region's all-American lifestyle and typically work in some form or fashion that is connected to the manufacturing nature of the local economy. The Cities of Lenoir and Hickory have populations of approximately 18,000 and 40,000 respectively (U.S. Census Bureau - North Carolina 2001). Due to the recent decline in manufacturing economy, the local area has incurred a substantial unemployment rate as locals with said skills suffer economic hardships and local municipalities work to attract businesses to the area for supplemental growth. Lenoir is located in the foothills of the Blue Ridge Mountains and carries with it the rich mountain culture, while Hickory is closer to

metropolitan areas while carrying residue of mountain culture in its innovative means of cultivating economic activity and the close knit community networks. Both Lenoir and Hickory are very similar in nature and economic activities. The existing manufacturing infrastructure coupled with the need of local areas to supplement economic activity and the connection to educational institutions make an ideal location for the presence of the manufacturing aspects of the CEE.

SWOT ANALYSIS

STRENGTHS

The Lenoir/Hickory area is crucial to the development of the WNC CEE in that it is a cluster of manufacturing businesses that can provide specialized knowledge in the production process of CEE technologies. The Lenoir/Hickory area is nationally recognized for its manufacturing capabilities, particularly in the furniture and textile industries and can provide a valuable resource for the CEE. Due to a combination of a growing globalized economy with the outsourcing of manufacturing industries and the recent economic recession, the area has suffered a tremendous blow to the local economy from the closing of several factories, resulting in the loss of more than 7,000 jobs, leaving a large portion of the specialized manufacturing workforce unemployed. The area is in need of supplemental sources of economic activity and is searching for new companies and industries to fill the void left behind. The culmination of the Lenoir/Hickory circumstances provides an ideal situation to build the CEE upon existing infrastructure and skilled labor force in great need of revitalization.

The Lenoir/Hickory areas connection to the manufacturing industry with its established physical infrastructure and social capital provides valuable resources for the

potential production of components for CEE technologies. The manufacturing factories in the area specialize in the production of furniture, textiles, automotive parts, and electronics/appliances, all applicable for the transition to CEE production. These capabilities can be applied towards the production of components for renewable energy technologies such as wind, micro-hydro, and solar just to scratch the surface. Components are a crucial part of manufacturing and can serve as a means for optimizing economic development opportunities within the area.

The Hickory (Catawba County) municipality launched the ECOComplex demonstration project, a progressive sustainable initiative that generates renewable energy produced from the methane off gases of a capped land fill and utilizes the land used for agricultural production by local farmer co-ops (Catawba County Government 2011). The educational institutions of the area play a crucial role in establishing the CEE to the local economy and include an ASU satellite campus and the Caldwell Community College among others. Although the recent development of the Google and Apple data warehouses centers have only provided limited economic growth to the area, they have opened new avenues of possibilities and serve as an important change into new markets. The culmination of these opportunities allows the proverbial Lenoir/Hickory area to get its foot in the CEE door, essentially setting the stage for the CEE development of the area though progressive demonstration projects, educational institutions and programs, and innovative companies opening new economic opportunities.

WEAKNESSES

There are little to no weaknesses as related to the Lenoir/Hickory area as a potential cluster for manufacturing components for the CEE. Like the other case studies the

Lenoir/Hickory area is prone to negative perceptions or simply a lack of awareness of the potential sustainable opportunities associated with the CEE, more so for the Lenoir/Hickory area based on its limited exposure to sustainable initiatives and lifestyles. The area suffers from its dependency on a vanishing sector do to extensive outsourcing and is rightfully concerned of similar pitfalls of adapting to new markets. The current economic situation serves as a dual issue, creating pressing issues for a need of change while restricting potential growth opportunities from investing due to the unstable nature of the economy. Although these clear and present weaknesses exist, they are for the scope of this research outweighed by the strength of the area concerning the development of the CEE.

OPPORTUNITIES

The opportunities of the Lenoir/Hickory area developing and competing in the CEE are very promising. The potential of the area capitalizing on its existing physical infrastructure and social capital provide the much needed hope of revitalizing the localized economic activities. This hope is crucial in battling the fear of similar economic downturn the area has recently fallen victim to. By capitalizing on the manufacturing capabilities of the area Lenoir/Hickory is able to carve a specialized niche out of the CEE and ensure a sustainable means of economic development while positively contributing to environmental stewardship. The opportunity to develop the manufacturing sector of the CEE is important in moving manufacturing jobs back into the nation and can serve as an initial step to shift from a globalized to a localized economy. The educational connections of the area serves an equally important role by properly providing any necessary means of transition for the specialized labor pool in addition to initiating demonstration projects to motivate and inspire continued growth.

Components will prove to be another crucial aspect of developing the CEE's manufacturing sector in the Lenoir/Hickory area. Much like the concept of compartmentalization and its applications in establishing separate units, so is that of the component theory to create as many economic opportunities as possible. By focusing on manufacturing components the Lenoir/Hickory area can optimize opportunities through economies of scale and potentially unlock additional process systems for further job creation. Raw materials are also available within the region that can be utilized in manufacturing renewable energy technologies, such as the world's largest quartz deposits in Spruce Pine that can be applied toward the production of PV panels. In addition the local textiles industry can produce carbon fiber blades for turbines and automotive capabilities converted for the manufacturing of gearbox's and other turbine components. These opportunities of capitalizing on component manufacturing process systems are real and possible solutions for an area already established in physical infrastructure and social capital to make the transition to the CEE.

THREATS

Much like the weaknesses of the Lenoir/Hickory area, the threats pale in compression to both strengths and opportunities for development of the CEE by capitalizing on the specialized knowledge and skills of the manufacturing clusters. The dominant threat comes in the form of fear, fear of a relapse into another collapse and desolation of local economies. The threats of starting manufacturing operations in new markets rightfully strike concern in the local communities. Though the opportunities of developing CEE hold promise and hope in succeeding where previous markets have failed, this fear is a real and present danger to the area capitalizing on such initiatives. Even with embargos on CEE components from China

and the continuous growth in localized CEE markets, the fear of being pigeon-holed into an undetermined economy is the single biggest threat of the area. There are the possibilities of over commercializing on the manufacturing industries, essentially loosing the particularity of place and jeopardizing the unique heritage of the area, becoming too big to support itself and imploding under its own weight. Although paling in comparison to benefits of developing the CEE manufacturing cluster in the Lenoir/Hickory area, the threats are nonetheless serious impacts that communities need to take into consideration before implementation.

SOCIAL NETWORKS

The social capital that operates in the Lenoir/Hickory area is a diverse network that spans within the WNC region and further, to both state and national levels. Key actors in the social network include those employed by local municipalities, businesses and entrepreneurs, regional economic development organizations, and those in various transitions. They scale vertically from Federal to local government structures to that of horizontally within the Lenoir/Hickory area community and amidst various organizations. Samples of five key actors within the Lenoir/Hickory community have been chosen to explore and demonstrate the interactions and connections of such social networks.

Barry Edwards is the Director of Catawba County Government's Department of Utilities and Engineering, a public service position that is interconnected and charged with leading the responsibility of Catawba County Government (CCG) in ensuring citizens can live, work, and recreate in a clean and safe environment through the approach of economically viable and environmentally friendly solutions (Edwards 2010). Mr. Edwards plays an important role in the development of the WNC CEE through his role as director of CCG's Utility and Engineering Department and his efforts in creating and maintaining the

EcoComplex, a resource recovery facility developed in partnership with ASU to utilize waste products for energy production from landfill methane gas and the production of products from raw materials (Catawba County Goverment 2011). The EcoComplex has received national media attention from both CNN and GE for its sustainable efforts of zero waste innovative design in industrial ecological systems. Mr. Edwards gained his specialized knowledge and certification as a NC registered structural and environmental engineer through NC State University and through the school of *hard knocks* by his experience through projects with the International City Management Association (ICMA) in partnership with the EPA in Albania, Morocco, and Afghanistan (Edwards 2010). Mr. Edwards utilizes his farming community innovation approaches to solving pressing issues by making due with existing resources to create tools and simply make it work mentality with the environmental knowledge that harmful residues introduced into ecosystems are difficult if not impossible to remove. Mr. Edwards waste management expertise parallels with the embedded innovative mountain culture by attaching a value stream to items. In addition to Mr. Edwards' connections to community through his public service responsibilities include that of university-industry relations such as zero waste or no need for landfills via combined principals of the Carolina Recycling Association (CRA) and the International Swine Board (ISB). He is considered to be an innovative expert in his field and occasionally gives lectures on his efforts to develop the CEE through waste reduction management. Mr. Edwards works diligently to promote triple bottom line through building code compliance and industrial ecological systems such as water, sewer, and erosion control.

David Waechter is both the Coordinator and an instructor at the Caldwell Community College and Technical Institute's Corporate and Continuing Education Department's Small

Business Center (CCCTISBC) and a Sustainability Consultant for the Caldwell County Green Commission (CCGC) (Waechter 2010). As a CCCTISMC Coordinator, Mr. Waechter is charged with supporting the development of new and the growth of existing businesses through community-based assistance. As a Sustainability Consultant for CCGC, he is similarly charged with working with existing local businesses on their sustainable efforts and attracting new companies to Caldwell County's growing green economy. Mr. Waechter gained his education, a Master of Arts in Business, from ASU and specializes in corporate governance and strategic business planning. He is connected to the community through his professional responsibilities and various civic interactions such as his church involvements, his local residence and personal interest in sustainable agriculture leading to his involvement with the local farming community and Cooperative Extension, local political party affiliates, and various local community events. Mr. Waechter is directly tied to ASU through CCCTI and the Caldwell County Chamber of Commerce (CCCC) through his specialized work, placing him in a unique position that ties education to economic outreach (i.e. innovative ways to engage commerce, exchanging progressive ideas with educational institutions and industry of the furniture monoculture). His strong ties to the local farming and business allows him to social network and spread the good word of integration to his community by implementing the CEE paradigm. Mr. Waechter was raised in Fletcher and still has family ties in Hendersonville, a sustainable and transferable culture that has attributed to strengthening his values. He is crucial to the development of the WNC CEE, particularly in his support of components as a key factor to the Lenoir/Hickory area's role in the CEE (e.g. Spruce Pine Quartz/Silica mines - value chain with associated inputs, raw components, assembly, and distribution).

Lane Bailey is the City Manager of Lenoir, where he essentially performs CEO-like duties for the City by implementing the nuts and bolts of everyday and long-term policy (Bailey 2010). The nature of Mr. Bailey's profession is influenced strongly by politics and involves providing results to economic development issues. Mr. Bailey works for the 18,000 citizens of Lenoir, who pass their wants and desires to City Council, who in turn provides the Mayor with goals and objectives to pass on to Mr. Bailey. His major tasks include ensuring existing businesses develop and attracting new businesses to the area. In 2007, Mr. Bailey achieved a huge economic development success by enticing Google to develop a server farm or data center in Lenoir. This was the first major breakthrough of economic development in the Lenoir/Hickory area since the collapse of the furniture industry. The development of Google marketed the area as a datacenter corridor and is impart responsible for the development of the more recent Apple datacenter in Hickory. Mr. Bailey obtained both his Bachelors and Masters from ASU. Mr. Bailey is connected to the community through small town politics (i.e., living in a fish bowl) that keep him in tune with local communities, civic organizations, businesses and education institutions. Mr. Bailey consistently interacts with local CCCC, Catawba County Economic Development Corporation (CCEDC), the local GreenWay, Rotary Club, and local schools (e.g. attempting to prevent drop-out to address challenge of education attainment required for a more educated workforce that can compete in advanced markets).

Wendy Johnson is a Business Services Representative for the Western Piedmont Workforce Development Board, at the Western Piedmont Council of Governments (WPCOG). Ms. Johnson is working to administer the State Energy Sector Partnership (SESP) grant that WPCOG received to assist businesses with new hire on-the-job training subsidies

and upgrade skills training for incumbent workers (Johnson 2010). In addition to personal interest in EERE, Ms. Johnson gained her specialized green knowledge from her experiences working three years with a semiconductor company as an Environmental, Safety, and Industrial Hygiene Training Coordinator and ten years of training and development within a fiber optics industry. Ms. Johnson is connected to the community through her workforce development efforts and staying active in the region through activities and educational opportunities with the CCGC and as a project advisor for the LOSRC's Clean Energy WNC project. Ms. Johnson also interacts with the NCSEA as a partner to the SESP grant and the NC Workforce Development Partnership (NCWDP) for updates and trends. A key component of Ms. Johnson's position is to meet with local community colleges and carry out objectives of the SESP grant, taking time to explain job creation and demand in EERE industries to institutions and trade groups.

John Wear is an Environmental Planner with the WPCOG and works on air and water quality plans and projects and also serves as a staff planner for a few smaller local municipalities (Wear 2010). Mr. Wear gained his education from Catawba College and UNC Charlotte, Bachelors in Environmental Studies and Masters in Geography with an emphasis on Community Planning respectively. Mr. Wear stays connected to local and regional communities through his work and frequently attends conferences and committee meetings such as NC American Planning association (APA) with workshops in SD and energy efficiency, Low Impact Development (LID) and LEED projects, and also puts on his own conference, the Uniform Air Quality Conference, where he works with the Reese Institute for the Conservation of Natural Resources (RICNR) at Lenoir-Rhyne University to sponsor and coordinate the conference.

CONCLUSION

By establishing a geographic profile, performing a SWOT analysis, and conducting interviews with community stakeholders to create a landscape of local social networks, it becomes evident that the Lenoir/Hickory area is also a learning region where specialized knowledge of sustainable lifestyles can be disseminated and CEE technologies manufactured into local, regional, and national markets. In Lenoir/Hickory the particularities of place provide an ideal situation for the research and development of sustainable principals and practices while essentially proving to be an established infrastructure and social capital for manufacturing CEE technologies. Analyzing the strengths, weaknesses, opportunities, and threats indicate that the situation present in Lenoir/Hickory offers a regional hub promoting specialized manufacturing economy nurtured by the local mountain culture and heritage ideal for initiating dynamic and innovative partnerships between learning institutions and regional industry towards a vibrant CEE. Interviewing a sample of key community stakeholders reveals (Figure 10) an interconnected social network across a variety of scales with strong ties to each study areas and linked through common goals of sustainable principles and practices.

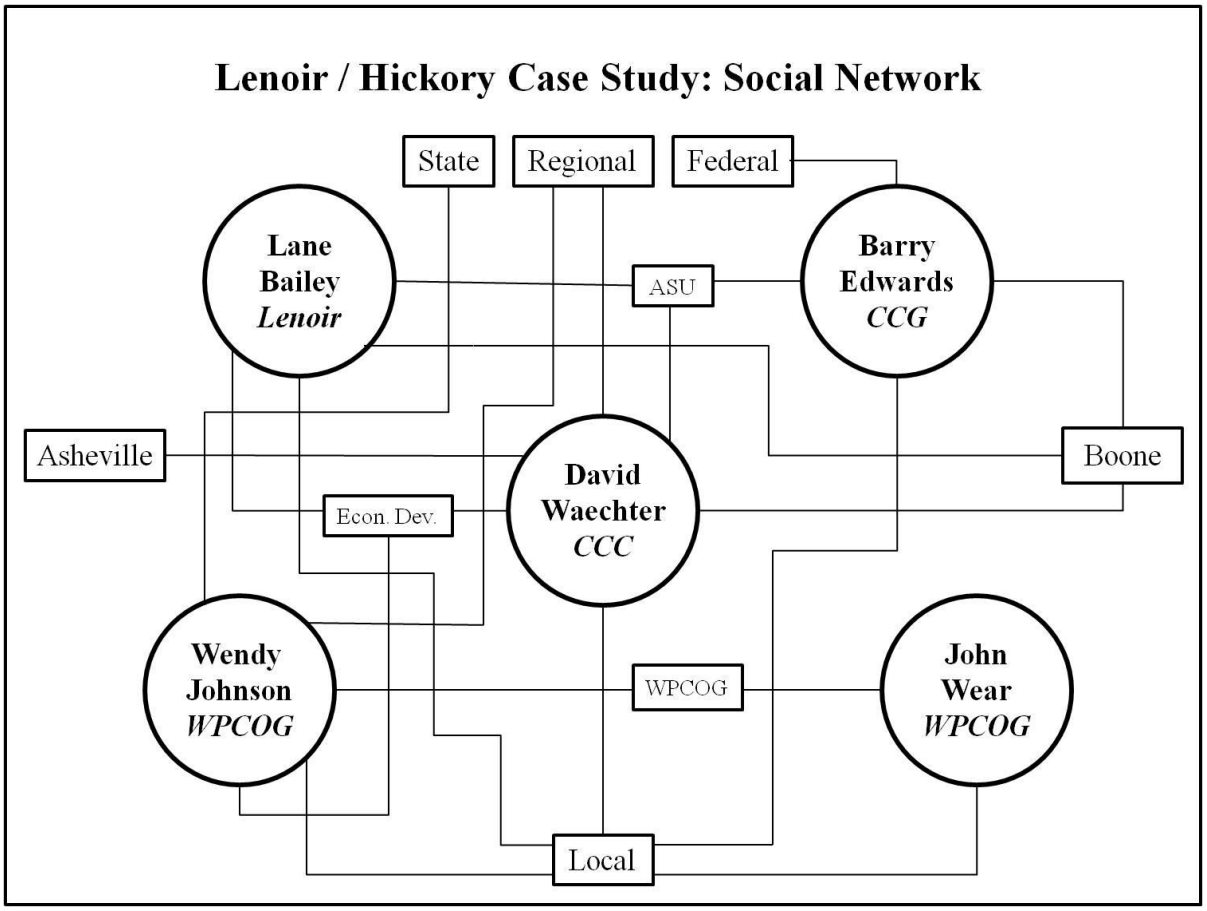


Figure 10. Lenoir / Hickory Case Study: Social Network.

CHAPTER 7 - CONCLUSIONS

The hypotheses of this research can be applied to a better understanding of solutions for pressing energy and economic issues of our time by gaining a working knowledge of the cluster dynamics within communities demonstrating sustainable lifestyles. In the case of this research, the study area's (Boone, Asheville, and Lenoir/Hickory) specialized knowledge of sustainable principles and practices are core concepts that set the foundation of these clusters success in regards to performing in the CEE.

The Boone area has been determined to be a learning region, where the development of sustainable lifestyles and the technologies applied therein are able to be disseminated in the community as an extended experimental laboratory. The social networks that operate in the Boone area are capable of extending from the progressive scholastic endeavors of the educational institutions into all levels of government and throughout the regional communities' key stakeholders, effectively influencing energy policy and establishing alternative means of economic stimulus.

The Asheville area has been determined to be an application region, where the dissemination of the specialized knowledge of sustainable lifestyles are put into practice through capitalization of such and successfully applied into markets generating CEE services. The social networks that operate in the Asheville area are capable of expanding through local municipalities and markets, regional economic development organizations, into all levels of government, and throughout the regional communities' key stakeholders, effectively influencing energy policy and establishing alternative means of economic stimulus.

The Lenoir/Hickory area has been determined to be a manufacturing or component region, where the potential of developing a manufacturing market catering to the CEE is clear and present, providing economic opportunity to capitalize on existing infrastructure and social capital. The social networks that operate in the Lenoir/Hickory area are capable of extending from the progressive educational institutions into all levels of government, local businesses and factories, and throughout the regional communities' key stakeholders, effectively offering opportunities to rise out of its economic ashes of hardships and rise to new heights of prosperity.

The energy policy from Federal to local levels and the incentives offered to progress alternative means of energy production and conservation is determined to play a crucial role in effectively and efficiently establishing foundations for the success of the CEE in the US. Although a vertical hierarchy exists within the structure of policy, each level holds its own importance to the integrated approach and holistic application of organization for legislation and regulation of energy issues. Federal policy sets the stage for national legislation and regulation standards of energy production, environmental interactions, and economic principals. State policy adopts national standards with options of promoting additional initiatives to guide state-wide goals as determined by its particular resources and needs. Local policy is then further expanded upon, catering to the particularities of place as determined by its constituents.

Of particular importance to the development of the CEE are incentives and prove to play a crucial role in conjunction with policy. Incentives can be offered throughout each level from Federal to local and come in many different forms to promote the development of the CEE by reducing inflated costs associated with alternative energy mechanisms. The

culmination of energy policy and incentives are determined to be of great importance and value in establishing the foundation of the CEE, in particular the clusters of WNC.

The types of energy policy and social networks explored in this research include those of which are foundational for the establishment of the CEE. Policy such as PURPA, EPAct, EISA, NCREEEPS, and NC State Building Energy Codes are but a few of the means which commonly exists for the CEE clusters of WNC to operate and thrive. The social networks in the study areas function within the scales of local to international communities, effectively uniting social capital of the sustainable movement and generating a unique economic niche capable of operating in a globalized system. The fact that these CEE clusters within WNC are capable of functioning in a globalized economy can be partially attributed to their strong foundations centered around educational institutions and the fluid dissemination of specialized knowledge through various means such as tactic and codified knowledge. The local economic profiles of the clusters in WNC are structured to optimize in localized regional markets with the scalability of competing in the globalized markets. The comparative advantages that exist in the study areas establish the area as a leader in the CEE, particularly in the Southeast US (Table 8).

Concerning the modeling of the study areas attributes to duplicate desired effects of generating developments of the CEE, this research has determined that the task will be a challenge at a minimum, warranting further research. By examining the economic profiles of the study areas to a greater extent will provide a better understanding of the economic dynamics that operate in each area, offering a detailed perspective of individual compositions and characteristic attributes. Considering the importance of particularities of place and the role of unique regional characteristics that is inherently present in the dynamics of the study

Table 8. WNC CEE Cluster Characteristic Matrix.

Characteristics / Attributes	Boone	Asheville	Lenoir / Hickory
Scalable place-based energy policy	X	X	
Dynamic performance-based financial incentives	X	X	
Social capital with specialized knowledge	X	X	X
Strong community support with proactive involvement	X	X	X
Regional connectivity	X	X	X
Educational institution – industry partnerships	X	X	X
Identifiable particularities of place	X	X	X
Infrastructure supporting economic development opportunities	X	X	X

areas, the research can only be applied in a limited capacity, allotting the study areas social networks and energy policy only be utilized as demonstration examples of CEE cluster development. Further research of transitional effects from the traditional American lifestyle towards targeted communities can potentially aid to better understand the implications of transformation on a larger scale in areas of main-line values. However, lessons learned from this research can be applied to other areas development of their own CEE and of sustainable lifestyles. Many of the examples in this research can be adopted into future energy policy by utilizing the case study findings and understanding of social network dynamics.

ABBREVIATIONS

AC – Air Conditioning

AEC – Appalachian Enterprise Center

AIRE – Appalachian Institute of Renewable Energy

AT – Appropriate Technology

APA – American Planning Association

ARC – Appalachian Regional Commission

ARRA – American Recovery and Reinvestment Act

ASES – American Solar Energy Society

ASU – Appalachian State University

ASUREI – Appalachian State University Renewable Energy Initiative

ASUSES – Appalachian State University Sustainable Energy Society

BBI – Boone Bike Initiative

BPE – Building Performance Engineering

BRPF – Biodiesel Research Project Facility

CAA – Clean Air Act

CCCTI – Caldwell Community College and Technical Institute

CCCC – Caldwell County Chamber of Commerce

CCCTISBC – Caldwell Community College and Technical Institute Small Business Center

CCEDC – Caldwell County Economic Development Corporation

CCG – Catawba County Government

CCGC – Caldwell County Green Commission

CEE – Clean Energy Economy

CERCLA – Comprehensive Environmental Response, Compensation, and Liability Act

CFWNC – Community Foundation of Western North Carolina

CO_2 – Carbon dioxide

CRA – Carolina Recycling Association

CWA – Clean Water Act

DAISE – Driving Appropriate Innovative Sustainable Education

DEOA – Department of Energy Organization Act

DOE – Department of Energy

DSIRE – Database of State Incentives for Renewable Energy

E3 – Economy, Equity, and Environment

ECPA – Electric Consumer Protection Act

EDF – Environmental Defense Fund

EERE – Energy Efficiency and Renewable Energy

EISA – Energy Independence and Security Act

EPA – Environmental Protection Agency

EPAct – Energy Policy Act

EPCA – Energy Policy and Conservation Act

ERA – Energy Reorganization Act

ERDA – Energy Research and Development Administration

ESA – Energy Security Act

ESI – Entrepreneurial Social Infrastructure

FEMA – Federal Emergency Management Agency

FERC – Federal Energy Regulatory Commission

GCC – Global Climate Change

GHG – Greenhouse Gas

HUD – Department of Housing and Urban Development

HVAC – Heating, Ventilation, and Air Conditioning

ICMA – International City Management Association

ISB – International Swine Board

kW – Kilowatt

LEED – Leadership in Energy and Environmental Design

LID – Low Impact Development

MARTA – Metropolitan Atlanta Rapid Transit Authority

MSA – Metropolitan Statistical Area

MTR – Mountain Top Removal

NAECA – National Appliance Energy Conservation Act

NASA – National Aeronautics and Space Administration

NCBC – North Carolina Biofuels Center

NCBST – North Carolina Board of Science and Technology

NCDA – North Carolina Department of Administration

NCDENR – North Carolina Department of Environment and Natural Resources

NCIF – National Capital Investment Fund

NCMWO – North Carolina Model Wind Ordinance

NCPG – North Carolina Project Green

NCREDC – North Carolina Economic Development Center

NCSEA – North Carolina Sustainable Energy Association

NCSEO – North Carolina State Energy Office

NCUC – North Carolina Utilities Commission

NCWDP – North Carolina Workforce Development Partnership

NCWWG – North Carolina Wind Working Group

NEA – National Energy Act

NECPA – National Energy Conservation Policy Act

NEP – New Environmental Paradigm

NEPA – National Environmental Policy Act

NIMBY – Not In My Back Yard

NOAA – National Oceanic and Atmospheric Administration

NREL – National Renewable Energy Laboratories

NRLP – New River Light and Power

NWPA – Nuclear Waste Policy Act

OPEC – Organization of the Petroleum Exporting Countries

PPA – Pollution Prevention Act

PURPA – Public Utilities Regulatory Policies Act

PV – Photovoltaic

RCRA – Resource Conservation and Recovery Act

REALITY – Rational Earth Actions Learning Institute, Thank You

REC – Renewable Energy Credit

REPS – Renewable Energy Portfolio Standards

RICNR – Reese Institute for the Conservation of Natural Resources

RIEEE – Research Institute on Environment, Energy, and Economics

SD – Sustainable Development

SECWNC – Sustainable Energy Council of Western North Carolina

SEE Expo – Southern Energy and Environment Expo

SESP – State Energy Sector Partnership

SWNC – Sustainable Western North Carolina

SWOT – Strengths, Weaknesses, Opportunities, and Threats

SWRDP – Small Wind Research and Development Project

TCE – True Costs of Energy

UNCA – University of North Carolina Asheville

US – United States of America

USACE – US Army Corps of Engineers

USDA – US Department of Agriculture

WNC – Western North Carolina

WNCGBC – Western North Carolina Green Building Council

WNCGBD – Western North Carolina Green Building Directory

WNCW – Western North Carolina Windows

WPCOG – Western Piedmont Council of Government

WWC – Warren Wilson College

WWII – World War II

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VITA

Matthew Steven Anthony was born in Waycross, Georgia on August 9, 1981 to Ronny Dean Anthony and Patti Bennett. He attended Mountain Oaks Elementary, Argyle Elementary, Griffin Middle School, and graduated from West Hall High School in May 1999. The following August he enrolled in Gainesville College and by May 2002 earned an Associate of Arts in Business Administration. The following June he entered the University of Georgia and received a Bachelor of Science degree in Consumer Economics in December 2004. He then enrolled at Appalachian State University in August 2007 to pursue a Bachelor of Science degree in Community and Regional Planning, but by August 2008 entered the Geography graduate program starting work towards his Master of Arts to be awarded in December 2012. He is a member of the Pi Gamma Mu International Honor Society.

Matthew began work as a carpenter in 1995, utilized the trade to pay for his education and continues practicing to this day. He first learned about Sustainable concepts while attending Gainesville College and began to apply the principals within the specialized field of Energy Efficiency and Renewable Energy during the timeframe of his attendance at the University of Georgia. His most notable experiences commenced while attending Appalachian State University include Appalachian Voices, ASU Sustainable Development Farm, and ASU Renewable Energy Initiative. He currently serves as a Coordinator for the Georgia Weatherization Assistance Program and plans to continue public service positions that allow him to apply his passion for implementing sustainable solutions.